2024

International Conference on Green Electrochemical Technologies

綠色電化學科技國際研討會 暨 2024台灣電化學學會年會

11 / 08 - 09 National Chung Hsing University

台灣電化學學會
The ElectroChemical Society of Taiwan
國立中興大學

PROGRAM

台灣電化學學會 The ElectroChemical Society of Taiwan
永續農業 創新發展中心 Innovation and Development Center of Sustainable Agriculture
國立中興大學 工學院工程科技研發中心
清華工學院 College of Engineering, NTHU
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TEO 先鋒科技 Titan Electro-Optics Co., Ltd.
SPIL 矽品精密 Siliconware
Nernst 能斯特科技

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Conference Address

Distinguished speakers, esteemed colleagues, and friends,

On behalf of the organizing committee, I am honored to welcome you to the **2024 International Conference on Green Electrochemical Technologies** (2024ICGET). This annual conference, generously supported by the International Society of Electrochemistry and The Electrochemical Society, has become an invaluable platform for advancing our sustainable and innovative solutions in electrochemical technologies.

The 2024ICGET, held on November 8-9, 2024, has brought together approximately 380 participants from 13 countries and regions, including Taiwan, Japan, South Korea, Mainland China, Hong Kong, Indonesia, Singapore, Thailand, India, Poland, Germany, the United Kingdom, and the United States. We are proud to host such a diverse and distinguished assembly of scholars, each bringing unique insights from their respective fields.

The conference program is enriched with 350 abstract submissions, featuring five plenary speakers, 19 keynote speakers, 56 invited speakers, and 21 oral presenters. We also had an oral competition with 54 participants and 192 posters containing 119 participants to join poster competitions.

Your participation, presentations, and discussions are essential to our collective progress in green electrochemical technologies. We are deeply grateful for your engagement and commitment. This conference will facilitate invaluable collaborations and innovations for a more sustainable future. Thank you for joining us, and we look forward to an inspiring and productive event together.

Warmest regards,

Ching-Chou Wu

Conference Chair, Ching-Chou Wu
Tenured Distinguished Professor, National Chung Hsing University

Welcome Notice

Dear all electrochemical scientists:

You are cordially welcome to the 2024 International Conference on Green Electrochemical Technologies (2024 ICGET-Tw) and the annual meeting of the Electrochemical Society of Taiwan (ECSTw) on November 8-9, 2024 in Taichung city. This conference is proudly co-organized by the ECSTw and National Chung Hsing University (NCHU).

The conference, co-chaired by Prof. Wu, Ching-Chou in NCHU, is a desirable platform for exchanging the information and knowledges as well as the latest achievements in the green electrochemical sciences and technologies. We will have presentations and discussion on all topics in electrochemistry. It also offers a unique opportunity to discuss a lot of basic researches on the green electrochemical technologies and to enhance our friendship and any possible collaborations during this conference. We sincerely look forward to your participation.

Best regards,

Conference co-Chair, Hu, Chi-Chang,
President, The Electrochemical Society of Taiwan,
Chair Professor, National Tsing Hua University

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Prof. Gou-Jen Wang	National Chung Hsing University

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Agenda

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08:30-	**Registration**					
09:00-10:20	**R105** - *Batteries*	**R101** - *Photoelectrochemistry / Electroplating*	**R102** - *Conversions*	**R203-2** - *Basic Electrochemistry*	**Poster competition (1F Hall) & Poster exhibition (2F Gallary) (9:00-13:30)**	**R204-1 & 204-2**
	Chair : Masayuki Morita KL-4. Aninda Jiban Bhattacharyya IL-10. Chun-Chen Yang Oral-1. Aknachew Mebreku Demeku Oral-2. Rio Akbar Yuwono	**Chair : Chih-Ming Chen** IL-4. Cheng-En Ho IL-5. Yu Ting Huang IL-6. Hou-Chien Chang IL-7. Yu-An Shen	**Chair : Andrew C. Chien** IL-6.Shao-Sian Li IL-7. Cheng-Ying Chen Oral-3. Sofiannisa Aulia Oral-4. Ding Huei Tsai Oral-5. Keseven Lakshmanan	**Chair : I-Ming Hsing** IL-6. Tsu-Chin Chou IL-7. Yan-Gu Lin IL-8. Po-Yu Chen IL-9. Yi-Ting Hsieh		**Oral competition**
10:20-10:35	**Coffee Break**					
10:35-11:15	**R105**					
	Plenary Lecture IV - *Basic Electrochemistry* **Prof. M. S. Gaur** (Chaired by **Prof. Ching-Chou Wu**)					
11:15-12:30	**R105** - *Batteries*	**R101** - *Photoelectrochemistry / Electroplating*	**R102** - *Conversions*	**R203-2** - *Basic Electrochemistry*		
	Chair : Fu-Ming Wang KL-5. Masayuki Morita IL-11. Yu-Lun Chueh IL-12. Watchareeya Kaveevivitchai	**Chair : Yu-Ting Huang** KL-4. Shien-Ping Feng IL-8. Heng-Jui Liu Oral-2. Yu-Jen Shih Oral-3. Chun-Hao Chang	**Chair : Andrew C. Chien** KL-2. Wei-Nien Su IL-8. Chun-Ting Li IL-9. Chun-Liang Chang	**Chair : Prof. Yi-Ting Hsieh** KL-3. Hnin Y. Y. Nyein IL-10. Lei Kerr IL-11. Ming Yu Yen		
12:30-13:30	**Lunch**					
13:30-14:10	**R105**					**Oral competition (~15:40)**
	Plenary Lecture V – *Photoelectrochemistry / Electroplating* **Prof. Hiroshi Imahori** (Chaired by **Prof. Chen-Yu Yeh**)					
14:10-16:10	**R105** - *Batteries*	**R101** - *Batteries*	**R102** - *Fast Energy Storage Materials and Devices*	**R203-2** - *Batteries*		
	Chair : Aninda Jiban Bhattacharyya, Yuan-Yao Li KL-6. Byungchan Han IL-13. Ching-Yuan Su IL-14. Yuan-Yao Li IL-15. Chih-Liang Wang Oral-3. Arumugam SuryaPrakash Oral-4. S. Kishore Babu	**Chair : Jeng-Kuei Chang, Yu-Sheng Winston Su** KL-7. Kazuhiko Matsumoto IL-16. Yu-Sheng Winston Su IL-17. Yu-Ze Chen IL-18. Hsiu-Fen Lin Oral-5. Pattarapope Mungkung Oral-6. Gemma Maskell	**Chair : Panitat Hasin, Daniel Chua** KL-7. Daniel Chua IL-16. Tai-Feng Hung IL-17. Marcin Krajewski IL-18. Panitat Hasin	**Chair: Sheng-Heng Chung, Ping-Chun Tsai** IL-19. Teng-Hao Chen IL-20. Ping-Chun Tsai Oral-7. Bereket Woldegbreal Taklu Oral-8. Chusnul Khotimah Oral-9. Sylvia Ayu Pradanawati Oral-10. Sanna Gull Oral-11. Yosef Nikodimos		
16:10-16:30	**Coffee Break**					
16:30-17:00	**R105**					
	Closing & Awards Ceremony					

Oral competition教室安排

11/8 Day 1	Room 204 -2	
	Topic A	
13:30-15:52	13:30-13:42	Cheng-Che Wu
	13:42-13:54	Zih-Jhong Huang
	13:54-14:06	Liang-Ting Wu
	14:06-14:18	Chi-Yu Lai
	14:18-14:30	Yu -Sheng She
	14:30-14:40	**Break**
	Topic E	
	14:40-14:52	Chia-Wei Chang
	14:52-15:04	Junan Wang
	14:04-15:16	Jin Xinyu
	15:16-15:28	Pin-Chun Lee
	15:28-15:40	Jin-Rong Chen
	15:40-15:52	Cheng-Hong Cai
15:50-16:10	Coffee break	
	Topic A	
16:10-17:30	16:10-16:22	Ashok Vallal Saravanan
	16:22-16:34	Li-An Kuo
	16:34-16:46	ChiJyun Ko
	16:46-16:58	Ting-Yu Wang
	16:58-17:10	RuiTung Kuo
	17:10-17:22	Asif Latief Bhat

11/9 Day 2		Room 204 -1	Room 204 -2
		Topic E	Topic B
09:20-10:20	09:20-09:32	Ming-Si Jian	Yu -Ru Liu
	09:32-09:44	Hsiang-Sheng Wei	Kang-Shun Peng
	09:44-09:56	Sooyong Choi	Chun-Jung Chang
	09:56-10:08	Kazuhiro Shibata	Wei-Ting Tu
	10:08-10:20	Pin Lui	
10:20-10:35		Coffee break	
		Topic A	Topic C
10:35-12:20	10:35-10:47	Manoj Kumar Senniyappan	Rene Mary Amirtha
	10:47-10:59	Cindy Rusly	Li-Xin Huang
	10:59-11:11	Le-Yen Lin	Qing-Yu Hu
	11:11-11:23	Tzu-Ching Chan	Yu -Hsuan Chiu
	11:23-11:35	Chiu-Neng Su	Ting-Jang Tsai
	11:35-11:45	Break	
		Topic A	Topic D
	11:45-11:57	Chun-Yen Yang	Bing-Chen Gu
	11:57-12:09	Ulya Qonita	Rohan Sagar
	12:09-12:21	Yi -Chun Lai	Shih-Huang Pan
	12:21-12:33	Yu -Chi Wang	Hao-Hsuan Hsia
12:30-13:30		Lunch	
		Topic A	Topic D
13:30-15:40	13:30-13:42	Yu -Ting Tai	Bushra Rehman
	13:42-13:54	Felika Valencia	Shota Kanno
	13:54-14:06	Ying -Chen Wu	-
	14:06-14:18	Shen-Fa Dung	Shun-Yu Tsai
	14:18-14:30	Bo-Yang Chuang	Ching-Hao Liu
	14:30-14:42		Ching-yu Chen

Lecture

Plenary Speakers

Inaba Minoru

Doshisha University

Si nano-flake anode for advanced lithium-ion batteries

R105, November 8th, 10:50 ~ 11:30

Chun-Wei Chen

National Taiwan University

Manipulating spin-polarized electrons of electrocatalysts and photocatalysts for energy conversion

R105, November 8th, 11:30 ~ 12:10

Seung-Taek Myung

Sejong University

Na-Based Cathode Materials Activated by Dual Redox Reactions

R105, November 8th, 13:30 ~ 14:10

Mulayam Singh Gaur

Hindustan College of Science and Technology, Farah (Mathura) U P

Graphene: Advances in Two Dimensional Material Synthesis, Properties and Biosensor Applications

R105, November 9th, 10:35 ~ 11:15

Hiroshi Imahori

Kyoto University

Molecular Engineering for Organic Solar Cells

R105, November 9th, 13:30 ~ 14:10

Keynote/ Invited/ Oral Speakers

Conversions	**November 8**
R101	

Hsiharng Yang **Invited speaker** **9:00 to 9:20**

National Chung Hsing University

Investigation of Various Membrane Assembly Electrodes for Direct Ammonia Fuel Cells

Tzu-Ho Wu **Invited speaker** **9:20 to 9:40**

National Yunlin University of Science and Technology

Probing the Effects of Preintercalated Anion Species on the Electrocatalytic Properties of Nickel Hydroxides for Urea Oxidation

YuChung Chang **Invited speaker** **9:40 to 10:00**

National Yang Ming Chiao Tung University

Metal-BINOL Nanostructures for Electrochemical H2 Evolution in Alkaline Media

Leigh Aldous **Oral speaker** **10:00 to 10:12**

National Taiwan University

An Introduction to the Emerging Area of Thermogalvanic Cells for Waste Heat Harvesting

Photoelectrochemistry/Electroplating	**November 8**
R101	

Yuh-Lang Lee **Keynote speaker** **14:10 to 14:40**

National Cheng Kung University

Novel Strategies for Improving the Performance of Dye-Sensitized Solar Cells

Satoshi Uchida **Invited speaker** **14:40 to 15:00**

The University of Tokyo

Nanoscopic Observation via FIB/TEM Systems for high performance Perovskite Solar Cells

Tom Macdonald (Thomas J. Macdonald) **Invited speaker** **15:00 to 15:20**

University College London

Crystal Growth Modulation of Tin-Lead Halide Perovskites via Chaotropic Agent

Kuan-Chieh Huang **Invited speaker** **15:20 to 15:40**

CPC Corporation

Development of Perovskite Solar Module Using Vacuum Processes

Martyn A McLachlan **Keynote speaker** **16:10 to 16:40**

Imperial College London

Developing novel green solvents and techniques for ambient processing of metal halide perovskites

Tzu Chien Wei **Keynote speaker** **16:40 to 17:10**

National Tsing Hua University

Potential Contribution of Perovskite Solar Cells to Taiwan's 2050 Net-Zero Solar Photovoltaic Goal

Pitchai Chandrasekaran **Oral speaker** **17:10 to 17:22**

National Chung Hsing University

Highly Efficient Bifunctional High-Entropy Perovskites as Catalysts for Water Splitting and Urea Oxidation Reactions

Keynote/ Invited/ Oral Speakers

Fast Energy Storage Materials and Devices	**November 8**
R102	

Meng-Chang Lin **Invited speaker** **9:00 to 9:20**

National Chung Hsing University

Evaluation of Storage and Recycling of Dual Graphite Batteries Using Ionic Liquid Electrolytes

Feng Hao Hsu **Invited speaker** **9:20 to 9:40**

Providence University

The energy storage mechanism for various MoO3 crystal structure in aqueous aluminum-ion solution

Jian-Zhang Chen **Invited speaker** **9:40 to 10:00**

Institute of Applied Mechanics

Atmospheric pressure plasma technology for fabrication of supercapacitor electrodes

Kalpana Settu **Oral speaker** **10:00 to 10:12**

Indian Institute of Information Technology Design and Manufacturing, Kancheepuram

Graphene Oxide/Laser-induced Graphene Composite Flexible Electrode for Supercapacitor Applications

Si Hyoung Oh (Cancelled) **Keynote speaker** **14:10 to 14:40**

Korea Institute of Science and Technology

Challenges and perspectives for developing practical rechargeable batteries based on multivalent metal electrodes

Gen Inoue **Invited speaker** **14:40 to 15:00**

Kyushu University

Design of Electrode Structure for Electrochemical Devices

Masashi Okubo **Invited speaker** **15:00 to 15:20**

Waseda University

Anomalous charge storage with concentrated aqueous electrolytes

Hong-Ping Lin **Keynote speaker** **15:20 to 15:50**

National Cheng Kung University

Synthesis of the N-doped Multiporous Carbon from Agricultural Wastes for Application in Supercapacitors

Conversions November 8

R102

Heng-Liang Wu **Keynote speaker** **16:10 to 16:40**

National Taiwan University

Vibrational Spectroscopy at Electrified Interfaces: Electrochemical Conversion Reactions

Chang-Ming Jiang **Invited speaker** **16:40 to 17:00**

National Taiwan University

Light-Driven Organic Transformation with Oxide-Based Photoelectrodes

Lian-Ming Lyu **Invited speaker** **17:00 to 17:20**

National University of Kaohsiung

Synthesis of Core-Shell CoS2-FexCo1-xS2 Nanooctahedra towards Electrochemical Water Splitting in the Alkaline Medium

Berhanu Mekonnen **Oral speaker** **17:20 to 17:32**

National Taiwan University of Science and Technology

Dual Single Atomic Sites anchored on S, N Co-doped tubular carbon for ORR in AEMFC

Keynote/ Invited/ Oral Speakers

Batteries	**November 8**
R105	

Bing-Joe Hwang **Keynote speaker** **9:00 to 9:30**

National Taiwan University

Recent Progress of Sulfide-based All-solid-state Lithium Metal Batteries (ASSLMBs) in SEED

Kuan-Zong Fung **Invited speaker** **9:30 to 9:50**

National Cheng Kung University

Optimization and Novel Electrode Preparation for Ni-rich Layered Oxide Cathodes

Tsan-Yao Chen **Invited speaker** **9:50 to 10:10**

National Cheng Kung University

Design of Benzoquinoid Cathode Materials for Lithium-ion Batteries

Hsisheng Teng **Keynote speaker** **14:10 to 14:40**

National Cheng Kung University

Gel Electrolyte Design for High Performance Lithium-Ion Batteries

Chi-Chang Hu **Invited speaker** **14:40 to 15:00**

National Tsing Hua University

Vertically Grown Graphene Layers for Promoting Uniformity of Lithium Deposits on Copper Substrates for Lithium Metal Batteries

Soorathep Kheawhom **Invited speaker** **15:00 to 15:20**

Chulalongkorn University

Improving Zinc-Ion Battery Efficiency through Ammonium Preintercalation in MnO2 Cathodes

Manunya Okhawilai **Invited speaker** **15:20 to 15:40**

Chulalongkorn University

Advanced Bio-based Materials for Zn-ion Batteries

Yi-Hung Liu **Invited speaker** **15:40 to 16:00**

National Central University

PVDF-CA Based Composite Solid Electrolyte with NASICON-Type Fillers for Solid-State Lithium/Sodium-Ion Batteries

Nae-Lih Wu	**Keynote speaker**	**16:00 to 16:30**

National Taiwan University

Investigating Halide-Based Ni-Rich NCM All-Solid-State Li-Ion Batteries

Chia-Chen Li	**Invited speaker**	**16:30 to 16:50**

National Tsing Hua University

Garnet-Based Composite Electrolytes with Enhanced Ionic Conductivity for Solid-State Lithium Batteries

Che-Ning Yeh	**Invited speaker**	**16:50 to 17:10**

National Tsing Hua University

Engineering Polar Materials to Mitigate the Shuttle Effect in Lithium-Sulfur Batteries

Shu-Hao Chang	**Invited speaker**	**17:10 to 17:30**

Chung Yuan Christian University

Anode Surface Treatment for Enhanced Stability of Lithium-Ion and Zinc-Ion Batteries

Keynote/ Invited/ Oral Speakers

Basic Electrochemistry	**November 8**
R203-2	

I-Ming Hsing	**Keynote speaker**	**14:10 to 14:40**

The Hong Kong University

Electrochemistry for Nucleic Acid based Diagnostics and Organic Electrochemical Transistor Platforms for Biomedical Applications

Masato Sone	**Keynote speaker**	**14:40 to 15:10**

Tokyo Institute of Technology

Material Property Control of Multi-layered Ti/Au Microcomponents by Electroplating Toward Ultra High-Sensitive MEMS Inertial Sensor

Chia-Ying Chiang	**Invited speaker**	**15:10 to 15:30**

National Taiwan University

Towards Sustainability – from Bio-industrial Waste to High-value Chemicals and Green Hydrogen Production

Cheng-Lan Lin	Invited speaker	15:30 to 15:50

Tamkang University

Enhanced Electrochromic Devices via Micropatterned Thin Films and UV-cured Electrolytes with in-situ Polymerization

Chung-Wei Kung	Invited speaker	16:10 to 16:30

National Cheng Kung University

Redox chemistry of cerium-based metal−organic frameworks and their roles in electrochemical applications

Yung-Tin Pan	Invited speaker	16:30 to 16:50

National Tsing Hua University

Reaction Incubated Electrodeposition of Cu as Cathodes for CO2RR

Tso-Fu Mark Chang	Invited speaker	16:50 to 17:10

Institute of Science Tokyo

Multiferroic Ferrite-Based Materails for Photodegradation of Organic Dyes

Ching-Yu Peng	Oral speaker	17:10 to 17:22

Tamkang University

Remediation of Chromium-Containing Groundwater with Flow-Electrode Capacitive Deionization (FCDI) System

Keynote/ Invited/ Oral Speakers

Photoelectrochemistry/Electroplating	**November 9**

R101

Cheng-En Ho **Invited speaker** **9:00 to 9:20**

Yuan Ze University

Crystallographic Microstructure of Electroplated Cu and Mitigation of Pinhole Formation

Yu Ting Huang **Invited speaker** **9:20 to 9:40**

Doctech Limited

Nanotwin-Assisted Copper Enhancing Structural Stability in Fine-Pitch Redistribution Layers for Advanced IC Packaging

Hou-Chien Chang **Invited speaker** **9:40 to 10:00**

National Chung Hsing University

The Optimization of Copper Electroplating Aiming at Uniformity Enhancement with the Numerical Model and Response Surface Method

Yu-An Shen **Invited speaker** **10:00 to 10:20**

Feng Chia University

Interfacial Reaction of Sn-Zn and Sn-Zn-Bi Alloys with Electroplated Cu

Shien Ping Feng **Keynote speaker** **11:15 to 11:45**

City University of Hong Kong

Electrochemical Nanotechnology for Energy Harvesting and Semiconductor Manufacturing

Heng-Jui Liu **Invited speaker** **11:45 to 12:05**

National Chung Hsing University

Transition Metal Dichalcogenides Based Heterostructure for Enhancing Photoelectrochemical Water Splitting

Shih Yu-Jen **Oral speaker** **12:05 to 12:17**

National Sun Yat-sen University

Heterostructure of spinel ferrite and titania nanotube array for photoelectrochemical degradation of pharmaceutical pollutants and simultaneous hydrogen generation

Chun Hao Chang **Oral speaker** **12:17 to 12:29**

National Yang Ming Chiao Tung University

Au/SiC Microfluidic Devices Fabricated by Rapid Laser Cladding for Photocatalytic Degradation of Water Pollutants

Batteries	**November 9**
R101	

Kazuhiko Matsumoto **Keynote speaker** **14:10 to 14:40**

Kyoto University

Impacts of electrolyte, interface, and substrate on the performance of sodium metal batteries

Yu-Sheng Winston Su **Invited speaker** **14:40 to 15:00**

National Yang Ming Chiao Tung University

Small Molecule PAHs for Dual Prelithiation in Li-ion Capacitors and Ultralong Cycle Life in Li-ion Anodes

Yu-Ze Chen **Invited speaker** **15:00 to 15:20**

National Cheng Kung University

Interfacial Strategies for Long-Cycling Stability Aqueous Zinc Ion Batteries

Hsiu-Fen Lin **Invited speaker** **15:20 to 15:40**

National Formosa University

Synthesis and Modification of Layered Oxide Cathodes for Sodium-Ion Batteries

pattarapope mungkung **Oral speaker** **15:40 to 15:52**

Kasetsart University

Sorghum Carbon Anode for Sodium-Ion Batteries

Gemma Anne Maskell **Oral speaker** **15:52 to 16:04**

Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg

Recrystallization of Polycrystalline LMNO to Single Crystalline Material

Keynote/ Invited/ Oral Speakers

Conversions	**November 9**
R102	

Shao-Sian Li **Invited speaker** **9:00 to 9:20**

National Taipei University of Technology

Bias-Free Solar to Ammonia Photoelectrochemical Conversion Using Perovskite-Silicon Tandem Absorber and 1T-MoS2 Integration

Cheng-Ying Chen **Invited speaker** **9:20 to 9:40**

National Taiwan Ocean University

Nontoxic, Earth-Abundant Metal Oxide/Chalcogenide Materials for Solar Cell Applications: Cu2O, Cu2ZnSn(S,Se)4, Cu2BaSn(S,Se)4, and Sb2(S,Se)3

Sofiannisa Aulia **Oral speaker** **9:40 to 9:52**

National Taiwan University of Science and Technology

Bimetallic Prussian Blue Analogue as an Efficient Electrocatalyst for High Value-added 2e-ORR/Zn Flow Battery

Ding Huei Tsai **Oral speaker** **9:52 to 10:04**

National Tsing Hua University

High CO2-accessible Electrochemical Surface Area Cu Cathode (HSA-Cu) for Zero-gap Electrocatalysis CO2RR

Keseven Lakshmanan **Oral speaker** **10:04 to 10:16**

National Taiwan University of Science and technology

Atomic Ni/Cu Catalytic Dual-Site for Highly Selective CO2-to-Ethanol Reduction

Wei-Nien Su **Keynote speaker** **11:15 to 11:45**

National Taiwan University of Science and Technology

Electrochemical Valorization with Green Hydrogen Production

Chun-Ting Li **Invited speaker** **11:45 to 12:05**

National Taiwan Normal University

Polymeric Chalcogenides as High-Performance Electrocatalysts for Dye-Sensitized Solar Cells

Chun-Liang Chang **Invited speaker** **12:05 to 12:25**

National Atomic Research Institute

Preparation and Characterization of Intermediate Temperature Metal-supported Solid Oxide Cell

Fast Energy Storage Materials and Devices	**November 9**
R102	

Daniel Chua **Keynote speaker** **14:10 to 14:40**

National University of Singapore

Exploring novel chalcogenide, phosphide and oxide composites for water splitting and thermoelectric applications

Tai-Feng Hung **Invited speaker** **14:40 to 15:00**

Ming Chi University of Technology

Win-win strategies in anode-less zinc-ion hybrid supercapacitors

Marcin Krajewski **Invited speaker** **15:00 to 15:20**

Institute of Fundamental Technological Research Polish Academy of Sciences

Quasi-Solid State Electrolyte Composed of Deep Eutectic Solvent and Gel-Like Polymer Membrane for High-Voltage Supercapacitors

Panitat Hasin **Invited speaker** **15:20 to 15:40**

Kasetsart University

Engineering Transition Metals-Decorated Heteroatomic-Doped Carbon Materials for Energy Storage Applications

Keynote/ Invited/ Oral Speakers

Batteries	November 9
R105	

Aninda Jiban Bhattacharyya **Keynote speaker** **9:00 to 9:30**

Indian Institute of Science

Multivalent Aqueous Rechargeable Batteries

Chun-Chen Yang **Invited speaker** **9:30 to 9:50**

Ming Chi University of Technology

Concentration Gradient Co-less Ni-rich LiNi0.92Co0.04Mn0.04O2 Layered Cathode Materials for Li-ion Batteries

Aknachew Mebreku Demeku **Oral speaker** **9:50 to 10:02**

National Taiwan University of Science and Technology

A Novel High-Entropy Oxide Catalyst as an Electrode Material for All- Vanadium Redox Flow Batteries

Rio Akbar Yuwono **Oral speaker** **10:02 to 10:14**

National Taiwan University of Science and Technology

An improvement of LiNiO2 cathode surface stability via an elevated oxygen partial pressure synthesis.

Masayuki Morita **Keynote speaker** **11:15 to 11:45**

Kyoto University

Research and Development of Zinc-based Rechargeable Batteries

Yu-Lun Chueh **Invited speaker** **11:45 to 12:05**

National Tsing Hua University

High-Performance Rechargeable Zinc Ion Batteries: From Surface-Modified Zn Anode and Structure-Engineered Cathode to Design of Deep Eutectic Solvent (DES)-Based Electrolytes

Watchareeya Kaveevivitchai **Invited speaker** **12:05 to 12:25**

National Cheng Kung University

Ultrahigh-performance Organic Electrode Materials for Sustainable Energy Storage Systems

Byungchan Han **Keynote speaker** **14:10 to 14:40**

Yonsei University

Design of Solid-state Electrolytes and Single Atom Catalysts for Electrochemical Energy Storage and Conversion Systems: DFT and Machine Learning Approach

Ching-Yuan Su **Invited speaker** **14:40 to 15:00**

National Central University

Functionalized Graphene Gradient Composite Layers as Artificial Solid Electrolyte Interfaces for Anode-Free Lithium Metal Batteries

Yuan-Yao Li **Invited speaker** **15:00 to 15:20**

National Chung Cheng University

Biomass-derived Activated Carbon for Rechargeable Li-Cl2 Batteries

Chih-Liang Wang **Invited speaker** **15:20 to 15:40**

National Tsing Hua University

Formation of Three-Dimensional Lithium Metal Composite Anodes with a Lithiophilic ALD Coating

Suryaprakash Arumugam **Oral speaker** **15:40 to 15:52**

National Taiwan University of Science and Technology

Tautomerism and Nucleophilic Addition Influenced Performance on Aqueous Organic Redox Flow Batteries of Chelidamic Acid and Chelidonic Acid

S Kishore Babu **Oral speaker** **15:52 to 16:04**

Chung Yuan Christian University

Improved Electrochemical Performance of MOF-derived Spinel NiCo2O4/SWCNT Composite as anode material for Na-ion Batteries

Keynote/ Invited/ Oral Speakers

Basic Electrochemistry	**November 9**
R203-2	

Tsu-Chin Chou **Invited speaker** **9:00 to 9:20**

National Tsing Hua University

Investigating Intermediates in the Electrochemical Reduction of CO2 through vibrational Spectroscopy

Yan-Gu Lin **Invited speaker** **9:20 to 9:40**

National Synchrotron Radiation Research Center

Synchrotron Characterization for Studying Electrochemical Interfaces

Po-Yu Chen **Invited speaker** **9:40 to 10:00**

Kaohsiung Medical University

Anode with the Catalytic Activity of Oxygen Evolution Reaction Renders Protic Ionic Liquids Sustainable in Metal Electrodeposition

YiTing Hsieh **Invited speaker** **10:00 to 10:20**

Soochow University

Development of Molecularly Imprinted Polymers Using Deep Eutectic Solvents for Electrochemical Sensing

Hnin Nyein **Keynote speaker** **11:15 to 11:45**

The Hong Kong University of Science and Technology

Realizing Electrochemical Sensors in Wearable Applications

Lei Kerr **Invited speaker** **11:45 to 12:05**

Miami University

Detection OF 8-HYDROXY-2'-DEOXYGUANOSINE (8-OHdG) IN ARTIFICIAL URINE

Ming Yu Yen **Invited speaker** **12:05 to 12:25**

Semiconductor industrial exhausted hydrogen gas purification and hydrogen safiety

Batteries	November 9
R203-2	

Teng-Hao Chen **Invited speaker** **14:10 to 14:30**

National Tsing Hua University

Development of performance, degradation and age prediction method for the active material in Li battery by using the in-situ X-ray scattering analysis

Ping-Chun Tsai **Invited speaker** **14:30 to 14:50**

Taiwan Tech

Electrochemical kinetics of polycrystalline and single-crystalline NMC811 cathodes for Li-ion batteries

Bereket Woldegbreal Taklu **Oral speaker** **14:50 to 15:02**

National Taiwan University of Science and Technology

Multilayered Stabilization of Lithium Metal Anode via Thermal Pyrolysis of Ammonium Fluoride in Lithium Metal Batteries

Chusnul Khotimah **Oral speaker** **15:02 to 15:14**

National Taiwan University of Science and Technology

Investigation of space group effects of High-Voltage spinel LiNi0.5Mn1.5O4: Unveiling the influences of fluorinate benzimidazole salt additive

Sylvia Ayu Pradanawati **Oral speaker** **15:14 to 15:26**

Universitas Pertamina

The Ionic Effect of Cerium Additives on Na2SO3 Based Solid Polymer Electrolyte

Sanna Gull **Oral speaker** **15:26 to 15:38**

National Tsing Hua University

Advancing Zinc Anode Performance in Aqueous Zinc-Ion Batteries through Pre-treatment Methods

Yosef Nikodimos **Oral speaker** **15:38 to 15:50**

National Taiwan University of Science and Technology

Approaches to improve moisture stability of Sulfide solid-state electrolytes

Oral competition

Batteries	November 8
R204-2	

Cheng-Che Wu **13:30 to 13:42**

National Cheng Kung University

Cement Host for High-Loading Lithium–Sulfur Cells

Zih-Jhong Huang **13:42 to 13:54**

National Cheng Kung University

Nickel Tungsten-Decorated Graphite Felt as a High-Performance Positive Electrode for Vanadium Redox Flow Batteries

Liang-Ting Wu **13:54 to 14:06**

National Taiwan University of Science and Technology

Electrolyte Design Principles for Li-Metal Batteries: An Electrochemical Perspective Using DFT, AIMD, and Machine Learning

Chi-Yu Lai **14:06 to 14:18**

National Tsing Hua University

Enhancing Zinc Electrode Stability Through Pre-Desolvation and Accelerated Charge Transfer via a Polyimide Interface for Zinc-Ion Batteries

YU-SHENG SHE **14:18 to 14:30**

National Taiwan University of Science and Technology

Influence of Additives on Interfacial Reactions and SEI Formation on the Li metal/Cu surface: Insights from DFT and AIMD Studies

Photoelectrochemistry/Electroplating	November 8
R204-2	

Chia-Wei Chang **14:40 to 14:52**

Tokyo Institute of Technology

NiFe2O4 Photocatalysts for Malachite Green Degradation: Effects of Sintering Temperature and Sonication on Catalytic Performance

Junan Wang **14:52 to 15:04**

Tokyo Institute of Technology

Enhancing the Efficacy of Organic Dye Degradation using Gold-Decorated $ZnFe_2O_4$ *Nanocrystals under Visible Light Irradiation*

Jin Xinyu **15:04 to 15:16**

Tokyo Institute of Technology

NiFe2O4 Photocatalysts for Malachite Green Degradation: Effects of Sintering Temperature and Sonication on Catalytic Performance

Pin-Chun Lee **15:16 to 15:28**

National Taipei University of Technology

Synthesis of ZIF-67 derivatives using structure directing agents coupled with nickel-iron metal-organic frameworks as electrocatalysts for water splitting.

Jin-Rong Chen **15:28 to 15:40**

National Taiwan Ocean University

Controlling Oxygen Vacancy Density in CuO/BiVO4 Composites to Enhance Photoelectrochemical Performance

Cheng-Hong Cai **15:40 to 15:52**

National Chung Hsing University

Defective TiO2 Nanorod Film by Chemical Reduction for Enhanced Dye Degradation

Batteries	**November 8**
R204-2	

Ashok Vallal Saravanan **16:10 to 16:22**

National Taiwan university of science and technology

Ni Single-atom catalyst's Crosstalk effect in Li–S Batteries: NiPc vs Ni-NC

LI AN KUO **16:22 to 16:34**

National Tsing Hua University

MoS2 composited with Highly-doped n-type Silicon Nanowire Anode and Free-Standing Anode for Lithium-Ion Battery

ChiJyun Ko **16:34 to 16:46**

National Taiwan University

Investigating Electrochemical Parameter Correlations via Sensitivity Analysis of EIS in Lithium-Ion Batteries

Ting-Yu Wang **16:46 to 16:58**

National Tsing Hua University

High-Performance Electrolytic Zn||MnO2 Battery Enabled by MOF-801 Coating

RuiTung Kuo **16:58 to 17:10**

National Tsing Hua University

Surface Modification of Ceramic Solid Electrolyte for Lithium Solid State Batteries with Amorphous-LLZO Thin Film

Asif Latief Bhat **17:10 to 17:22**

National Yang Ming Chiao Tung University

Understanding the Coulombic Efficiency Trough in Silicon Anodes for Lithium-Ion Batteries

Photoelectrochemistry/Electroplating	**November 9**
R204-1	

Ming-Si Jian **9:20 to 9:32**

National Tsing Hua University

Microstructure of Electrodeposited Aluminum on Aluminum and Copper Substrates in an AlCl3/Urea Ionic Liquid Analog Electrolyte

Hsiang-Sheng Wei **9:32 to 9:44**

National Tsing Hua University

Highly Efficient Electroplating of (220)-oriented Nano-twinned Copper in the Methanesulfonic Copper Baths

Sooyong Choi **9:44 to 9:56**

Chung-Ang University

Holely polyimide film-based anisotropic interconnection system with electroplated Cu via and Sn/Bi soldering bumps

KAZUHIRO SHIBATA **9:56 to 10:08**

Institute of Science Tokyo

Electroless plating of Ni-P/Nylon Fiber by Supercritical CO2 Catalyzation toward Weavable Devices

Pin Lui **10:08 to 10:20**

National Chung Hsing University

Effect of Organic Cuprate Concentration on Photoelectrochemical Properties of Particulate TiO2 Films

Batteries	**November 9**
R204-1	

Manoj Kumar Senniyappan **10:35 to 10:47**

Ming Chi University of Technology

Evaluating the cyclability of biphasic Na3V2(PO4)3/Na3V3(PO4)4 compound in ether-based electrolyte for sodium-ion batteries

Cindy Rusly **10:47 to 10:59**

National Taiwan University

Upcycling of Spent NiMH Batteries for the Recovery of Nickel-Manganese-Cobalt Electrode Precursors

Yu-Chi Wang **10:59 to 11:11**

National Taiwan University

Probing Ionic Transport in Polymer Solid Electrolyte

Tzu-Ching Chan **11:11 to 11:23**

National Cheng Kung University

Electrochemically Stable Lithium–Sulfur Cells with a Structural Designed Separator/Electrolyte

Chiu-Neng Su **11:23 to 11:35**

National Taiwan University of Science and Technology

A First-Principles molecular dynamics study of Li+ solvation structures and reduction Mechanisms in THF/MTHF containing electrolytes for Lithium metal Batteries: Comparative analysis of pristine Li and Li-Al alloy anodes

Batteries	**November 9**
R204-1	

Le-Yen Lin **11:45 to 11:57**

National Taiwan University, Taipei, Taiwan

Kinetics of Mixed Ion-Electron Transport in Composite Electrodes

Ulya Qonita **11:57 to 12:09**

National Taiwan University of Science and Technology

Spontaneous Lithium Corrosion with a Tetraglyme as an Electrolyte Solvent in Li-CO2 Batteries

Yi-Chun Lai **12:09 to 12:21**

National Taipei University of Technology

Advanced Sodium-Ion Battery Anodes: Cobalt Selenide Nanocubes with Carbon Coating Derived from Prussian Blue Analogues Demonstrating Exceptional Capacity and Long-Cycle Stability

Yu-Ting Tai **13:30 to 13:42**

National Cheng Kung University

Revealing the Inhibitory Impact on Li-ion Transport Arising from Co Diffusion at Solid Electrolyte LATP and Cathode LiCoO2 Interface

Felika Valencia **13:42 to 13:54**

National Taiwan University of Science and Technology

Enhancing Stability of Anode-Free Lithium Metal Batteries through Dual-Salt Electrolyte Formulation: Inhibiting Aluminum Corrosion

YING-CHEN WU **13:54 to 14:06**

National Tsing Hua University

Microstructure of Electrodeposited Magnesium after Discharge/Charge Cycles on Pure Magnesium and Copper Current Collectors for Rechargeable Magnesium Battery

Shen-Fa Dung **14:06 to 14:18**

National Taipei University of Technology

Defect Engineering in Antimony Selenide via Bismuth Ion Doping for High Stability Sodium-ion Battery Anodes

Chuang Bo-Yang **14:18 to 14:30**

National Taipei University of Technology

Water/Ethanol-Based and CTAB-Enhanced SnS_2*-Ultraphene Composites for Efficient Sodium-Ion Battery Anodes*

Conversions	**November 9**
R204-2	

Yu-Ru Liu **9:20 to 9:32**

National Taiwan University of Science and Technology

High-entropy Prussian blue analogues derived metal phosphide for electrocatalytic hydrogen evolution reaction in alkaline media

Kang-Shun Peng **9:32 to 9:44**

National Yang Ming Chiao Tung University

Spatial Confinement Enhancement and Orbital Modification of CopperAluminum Alloy Encapsulated within Carbon Nanofibers for Ampere-Level Carbon Dioxide Reduction Reaction

Chun-Jung Chang **9:44 to 9:56**

National Cheng Kung University

2D Bismuth Nanosheet for Electrocatalyzed Reduction of Carbon Dioxide

Wei-Ting Tu **9:56 to 10:08**

National Tsing Hua University

Cation Effect of Faceted Copper Electroplating under CO2 Atmosphere for CO2 Reduction Reaction

Fast Energy Storage Materials and Devices	**November 9**
R204-2	

Rene Mary Amirtha **10:35 to 10:47**

Ming Chi University of Technology

Constructing the zincophilic Cu current collector towards highly efficient anode-less zinc-ion hybrid supercapacitors

Li-Xin Huang **10:47 to 10:59**

National Taiwan University of Science and Technology

Reduced-graphene Oxide based Bifunctional Electrode for High-performance Dye-sensitized Photo-rechargeable Ion Capacitors

Qing-Yu Hu **10:59 to 11:11**

National Cheng Kung University

Unlocking the Potential of Lithium–Ion Capacitors: Enhancing Performance Across Room and High-Temperature Conditions with LiBF4 and THP-Based Electrolytes

Yu-Hsuan Chiu **11:11 to 11:23**

National Taipei University of Technology

Synthesis of Ni-Co prussian blue analogous nickel-free precursor on nickel foam as a binder-free electrode for high-efficiency electrocapacitive materials for battery supercapacitor hybrids

Ting-Jang Tsai **11:23 to 11:35**

National Tsing Hua University

Hierarchical Ni-Mn Oxides@Silicene Flower as Anode Materials for Fast-Charging Lithium-ion Batteries

Basic Electrochemistry	**November 9**
R204-2	

Bing-Chen Gu **11:45 to 11:57**

National Chung Hsing University

Artificial Intelligence-Assisted Electrochemical Detection of Short-Chain Fatty Acids

Rohan Sagar **11:57 to 12:09**

National Chung Hsing University, Taichung City, Taiwan

Ultrasensitive and Simultaneous Detection of Dopamine, Ascorbic Acid, and Uric Acid Using Au@MOF-60 Nanocomposite-Coated Screen-Printed Carbon Electrode

Shih-Huang Pan **12:09 to 12:21**

National Taiwan University of Science and Technology

A Multi-Scale Study of Potential-Dependent Ammonia Synthesis on IrO2 (110): DFT, 3D-RISM, and Microkinetic Modeling

Hao-Hsuan Hsia **12:21 to 12:33**

National Taiwan University of Science and Technology

Experimental and theoretical calculations of fluorinated few-layer graphene/epoxy composite coatings for anticorrosion applications

Basic Electrochemistry	**November 9**
R204-2	

Bushra Rehman **13:30 to 13:42**

National Tsing Hua University

3D WS_2/WSe_2 Heterostructures: A Novel Platform for Enhanced SERS and Hydrogen Evolution Reaction Applications

Shota Kanno **13:42 to 13:54**

Institute of Science Tokyo

Micro-Mechanical Property of Electrodeposited Gold: Designing Movable Components in MEMS Devices

13:54 to 14:06

Shun Yu Tsai **14:06 to 14:18**

Department of Material Science and Engineering

Recovery of Used Slurry from Chemical Mechanical Polishing via Electrophoresis Process

Ching-Hao Liu **14:18 to 14:30**

National Tsing Hua University

Crosslinking-enabled core-shell nanostructure based on conductive polymer hydrogels/carbon nanotubes for salivary glucose biosensore

Ching-y Chen **14:30 to 14:42**

National Tsing Hua University

Nitrogen Doped Carbon Materials Derived from Nickel-organic Materials for Electrocatalyzed Reduction Reaction of Carbon Dioxide

Poster Competition

Date：Nov. 8th
Location：1F Hall
Posting time：10:00~17:00
Competition time：12:30~14:10

TOPIC：Batteries

Poster no.	Paper no.	Abstract	Presenter
PC-A01	0047	A 3D carbon current collector for lithium-metal batteries	Hong-Ruei Su
PC-A02	0048	A PAN/PMMA membrane for high-performance lithium-sulfur cells	Yi-Wei Chen
PC-A03	0050	An Effective Performance Graphite Felt Modified by Copper-Doped Cobalt Oxide (Cu-Co3O4) Nanowires as Positive Electrode for Vanadium Redox Flow Batteries	Yu-Ling Wang
PC-A04	0061	Optimization of Gel Polymer Electrolyte for Chloride-ion Battery	Pandeeswari Jayaraman
PC-A05	0078	Oxide Solid-state-electrolyte Lithium–Sulfur Cells	Yuan-Chin Chu
PC-A06	0083	A Bridge Function of Cis-Isomerism Oligomer to Prevent the Carbonate Solvent Degradation on Ni-rich Layered Oxide Cathode	Laurien Merinda
PC-A07	0089	All-solid-state Lithium-Sulfur Batteries	Shih-Lun Yang
PC-A08	0093	Alkali Metal Ion Stabilized Vanadium Oxides as High-Areal-Capacity Cathodes for Zn-Ion Batteries	Liang-Jun Guo
PC-A09	0100	Ab-initio Study of Chemical and Electrochemical Stability between Solid-state Electrolytes and Cathodes in Solid-state Lithium Batteries	Chao-Hsiang Hsu
PC-A10	0111	Fabrication of Tungsten Carbide Electrodes Using Ultrasonic Spray Coating	Chih-Hsuan Liang

		Technology and Their Properties Analysis	
PC-A11	0115	Electronic and Ionic Conductivity as a function of State-of-charge in NMC811	Sung-Chuan Kao
PC-A12	0123	Enhancing Lithium-Sulfur Batteries with Recycled Waste Materials for Sustainable Energy Storage	Ci-Rong Deng
PC-A13	0125	Evaluations of AgVO3 polymorphs in aqueous Zn-ion batteries	Yu-Chong Lin
PC-A14	0146	DFT Analysis of Mg-ion Diffusion in SEI Layers and SEI/Magnesium anode Interface for Magnesium Metal Batteries	Zhong-Lun Li
PC-A15	0156	Nitrided TiO2 covers graphite felt as the negative electrode for vanadium redox flow battery	Hung-Yu Lai
PC-A16	0157	Using first principle molecular dynamics to explore the differences in the solvation structures of carbonate and ether based localized high-concentration electrolytes in lithium metal batteries	CHANG, HSIEN SHUN

TOPIC：Conversions

Poster no.	Paper no.	Abstract	Presenter
PC-B01	0034	A Ni(OH)2/COF Heterojunction Electrocatalyst for Urea Oxidation Reaction	Tzu-Ho Wu
PC-B02	0056	Molybdenum-Preintercalated Nickel Hydroxide as a Catalyst for Urea Electrolysis	Lee, Yi-Ying
PC-B03	0105	F-doped Graphene Quantum Dots Decorated Carbon Nanotube as an Efficient Electrocatalyst for High value-added 2e- ORR/Zn Flow Battery	Tzu-Ting Liu
PC-B04	0114	Evoking the Dynamic Fe-Nx Active Sites through the Immobilization of Molecular Fe Catalyst on NGQDs for the Efficient Electroreduction of Nitrate to Ammonia	Andrei Bernadette

PC-B05	0117	Efficient Fabrication of High-Loading Single-Metal Electrocatalysts Using Electrochemical Templates and Cationic Substitution	張家瑜
PC-B06	0130	Bimetallic Dual-Ligand Nickel-Based Metal-Organic Frameworks as Electrocatalysts for Hydrogen Production from Urea Electrolysis	Jia-He Peng
PC-B07	0148	Investigating Ammonia Decomposition Catalysts for Application in Medium and Low Temperature Proton Fuel Cell	Denny H. Kuo
PC-B08	0152	Hollow Multi-Shelled Cuprous Oxide with Multiple Confined Spaces Enables Highly Efficient Carbon Dioxide Reduction Reaction to Ethylene	Yung-Hsi Hsu
PC-B09	0153	Hydrophobic-Molecule-Modified Copper Oxide Nanotube Catalysts for Ampere-Level Carbon Dioxide Reduction Reactions to C2 Products	Yu-Chia Chang
PC-B10	0174	Novel High Entropy Oxide Materials for Energy Conversion System	Jue-Hua Pan
PC-B11	0178	Study of Polyaniline Electrodes Combined with Novel Ion-Gel Electrolyte in Magnesium Ion-Based Symmetric Supercapacitors	鄧名傑
PC-B12	0199	Tandem Catalysis System Utilizing Three-Dimensional Covalent Organic Frameworks Molecule on Copper Nanowire for Enhanced Electrocatalytic CO_2 Reduction to C_2 Products	Yu-Chun Liu
PC-B13	0200	Polypyrrole Coated Nickel-Metal Organic Framework As Anode Catalyst for Direct Urea Fuel Cell	陳姿均
PC-B14	0208	Cell Performance of B-site doped LST modified NiO/YSZ Cathodes for CO2 Reduction in a Solid Oxide Electrolyzer	錢彥銘

PC-B15	0209	ZIF-Derived Bismuth-Doped Carbon: Unlocking Efficient CO2 Reduction for Green Energy Solutions	Shao-Wei Lu
PC-B16	0219	Nitrogen-Containing Wastewater Fuel Cell	Andrew C. Chien
PC-B17	0282	Ce Decorating Carboxylic Acid-Based Nickel Iron Metal-Organic Framework Electrocatalysts for Alkaline Seawater Electrolysis in the Membrane Electrode Assembly	Yu-Ting, Chueh
PC-B18	0331	First-Principles Study on High-Entropy PtZnPBi Alloy as an Effective Electrocatalyst for Hydrogen Evolution Reaction	Yonghak Park
PC-B19	0336	Electrodeposition of Iridium on Tungsten Substrates: A High-Efficiency PTE for Water Splitting	Chang-Ming, Wu

Date：Nov. 8th
Location：1F Hall
Posting time：10:00~17:00
Competition time：14:50~16:10

TOPIC：Batteries

Poster no.	Paper no.	Abstract	Presenter
PC-A17	0167	Enhanced Aqueous Zn/MnO_2 Batteries with Adenosine-containing Electrolyte and Its Mechanistic Studies on Zinc Plating/Stripping	Shih-Che Lin
PC-A18	0168	Optimizing NASICON Structure Na3V2(PO4)2F3 as Sodium Ion Battery Cathode with Different Amount of Citric Acid via Spray Dry Method	Huang Chen En
PC-A19	0170	Application of Artificial Interphase on Ni-Rich Cathode Materials in All Solid State Li-Ion Batteries	Cheng-Hung Liao
PC-A20	0173	Innovative Nickel/Sulfur Tape-cased Cathodes for Long-life Lithium–Sulfur Cells	Yu-Pei Chiang
PC-A21	0180	Enhancing Ionic Conductivity and Moisture Stability in Br-rich Argyrodite Electrolytes for All-Solid-State Batteries through Structural Optimization and Doping	Chai-Lung Hsieh
PC-A22	0182	Improving Interface Stability and Cycle Life in Na_3SbS_4 Electrolytes via Double-Sided Polymer Coating	CELASTIN BEBINA THAIRIYARAYAR
PC-A23	0183	Sulfide artificial layer constructs solid-state electrolyte-free silicon-based anode	HSU,JUI-HUNG
PC-A24	0186	Modeling Non-Uniform Lithium Plating and Capacity Degradation on Realistic Rough Anode Surfaces	Ming-Yuan, Hung

PC-A25	0188	Spatiotemporal Mapping of Grain Boundary and Defects to Reveal the Degradation of Sulfide and Polymer Solid-State Electrolyte Sheet at Various States of Charge	Tsung-I Yeh
PC-A26	0189	"Novel In-situ Encapsulation of Tin Phosphide Particles in MXene Conductive Networks as Anode Materials of the Durable Sodium-ion Battery"	Wei-Cheng Chen
PC-A27	0190	Localized High-Concentration Electrolytes for High-Voltage Anode-Free Lithium Metal Batteries	Hsin-Chi Liu
PC-A28	0191	Studying the SEI Formation Mechanism in Lithium Metal Batteries with Fluoroethylene Carbonate Additives Using X-ray Scattering	Hsieh, Han-Hsuan
PC-A29	0192	Using Lithium Perchlorate as a Lithium Salt in Flame-Retardant Electrolytes to Reach High-Safety Lithium Metal Batteries	Wen-Chen Tsai
PC-A30	0195	Study of Lithium Deposition in PEO-Based All-solid-state Lithium Metal Batteries Using In-Situ Confocal Optical Microscopy	Yi-Fen Hung
PC-A31	0196	The research of sulfide and gel-polymer composite electrolytes membrane by UV-cured procedure in all solid-state lithium battery	Chang-Lin Liu
PC-A32	0201	Modeling Microstructure and Interfacial Contact in Composite Cathodes of All-Solid-State Batteries Using Finite Element Analysis and Machine Learning	Hong-Zhang Huang

TOPIC：Photoelectrochemistry/Electroplating

Poster no.	Paper no.	Abstract	Presenter
PC-E01	0091	"Enhancements on oxygen vacancy and light absorption of alkaline etched BiVO4 for photoelectrochemical water oxidation"	Chuang Kai Jie
PC-E02	0098	Hetero-Structured CuBi2O4 Photocathodes for Efficient Photoelectrochemical Water and Furfural Reduction	Manoj Kumar Mohanta
PC-E03	0154	The effect of annealing temperature on the crystal structure and photoelectrochemical properties of titanium dioxide nanotubes	Cheng-Chung Chen(陳正忠)
PC-E04	0187	(111) Orientation Nanotwinned Copper with Well-Controlled Morphology by System-Optimized Electropolishing	H. Tsou
PC-E05	0239	Modulation of twin spacing of (111)-orientation nanotwinned copper by altering aeration flow in high-speed electroplating system with thiol organic additives	Kuan-Ling Liu
PC-E06	0284	Investigation of Thermal-Induced Warpage in an Octagonal-Shaped Electrodeposited Gold MEMS Proof Mass with a Ti/Au Multi-Layered Structure	T. Mori
PC-E07	0317	Corrosion study of electroplated copper with different microstructures and crystal orientations in alkaline medium	Yen Ju Chu
PC-E08	0333	Low-Temperature Processable Electrodeposited TiO2 as the Electron Transport Layer in an Efficient Plastic Perovskite Solar Cell	Ha-Phuong Ngo Thi

Date：Nov. 9th
Location：1F Hall
Posting time：10:00~16:00
Competition time：11:20~12:30

TOPIC：Batteries

Poster no.	Paper no.	Abstract	Presenter
PC-A33	0203	Investigating the Role of Benzimidazole-Based Salt Additives for Enhanced High-Voltage Stability in NCA-Based Lithium-Ion Batteries	Ervina Nur Azizah
PC-A34	0204	Investigation of Surface Oxides Layer Removal on Cu Current Collector and Its Influence on Electrochemical Performance of Anode Free Lithium-ion Battery System	Salva Salshabilla
PC-A35	0210	The First Principle Study of P2-Type Layered-Oxide Anionic Redox Cathodes for Sodium-Ion Batteries Incorporating K-Doping	Yo-Hsuan CHEN
PC-A36	0211	Ti-based MOF modified copper current collector for lithium dendrite suppression	Pei-Hsing Chia
PC-A37	0213	High-energy Ball Milling of Si/Sn/C Composites as Anode Material for Lithium-ion Batteries	Yu-Ching Wen
PC-A38	0216	Advanced Sulfur Hosts Using Transition Metal Sulfide-Carbon Composites for High-Performance Lithium-Sulfur Batteries	Yu-Wei Chuang
PC-A39	0217	Effects of vanadium bronze/rGO nanorods for better electrochemical behavior as positive electrodes for Magnesium ion Batteries.	Thirbika Sathiyamoorthy
PC-A40	0225	Three-dimension metal foam applied to anode free battery	Yu-Chieh Su

PC-A41	0228	NiMn-Layered Double Hydroxides@NiMnZn Anchored Nitrogen-Doped Carbon Framework as a Bifunctional Catalyst for Rechargeable Zinc-Air Batteries	Ko-Fan Tu
PC-A42	0230	Cu, Fe bimetal doped ZIF8 deposited on the reduced Graphene oxide as the cathode catalyst of proton exchange membrane fuel cell	Pinyi Xu

TOPIC：Fast Energy Storage Materials and Devices

Poster no.	Paper no.	Abstract	Presenter
PC-C01	0032	Atmospheric-Pressure Plasma Jet Process for Flexible Asymmetric Supercapacitors with rGO and Lithium Manganese Oxide Electrodes	Ci-Song Chen
PC-C02	0033	Fabrication of Flexible Asymmetric Supercapacitors with Electrodes of rGO and LiMn2O4 Using Furnace and Atmospheric Pressure Plasma Jet	Bo-Yan Hong
PC-C03	0065	Synergistic Impact of Electrolyte Additives on Self-discharge Phenomena in Activated Carbon-Based Supercapacitors.	Yun Ku
PC-C04	0087	Metal Species Dependent Sulfurization of Cobalt, Iron and Copper Based Active Materials Using Thioacetamide for Energy Storage	Yan-You Liu
PC-C05	0118	Enhanced electrochemical properties of zinc manganese oxide/carbon nanocomposite electrode for supercapacitors	Jia-Jun Ye
PC-C06	0138	Low-Temperature, High-Efficiency Growth of Nano-Porous Cypress-Like 3D Graphene as A Conductive Additive	Pin-Jun Yeh

		for Improving Applications in Supercapacitors	
PC-C07	0165	In-situ Growth of Novel Iron Oxide/Iron Organic Framework Composites as Efficient Electroactive Materials of Battery	Shun-Feng Kuan
PC-C08	0184	Metal ratio and bimetal nanoarchitectonics of ammonia-based fluoride complex induced nickel hydroxide and manganese oxide composites as active materials of an energy storage device	You Zher Yu
PC-C09	0206	Low Cost Activated Carbon Derived from Bamboo-leaf Composited with SrFe12O19 Perovskite as Novel Electrode Material for Supercapacitor Applications	Somya Samantaray
PC-C10	0207	Development of 2.1V Wearable Energy Storage Devices Using a Novel Zinc Ionic Liquid-Based Neutral Gel Electrolyte and NiCo Hydroxide//Mn Oxide Asymmetric Electrodes	Min-Jay Deng(鄧名傑)*

TOPIC：Basic Electrochemistry

Poster no.	Paper no.	Abstract	Presenter
PC-D01	0035	Atmospheric-Pressure Plasma Jet Processed NiMoO4/Carbon Paper Electrocatalysts in Anion Exchange Membrane Water Electrolysis	Chen-Chen Chueh
PC-D02	0037	Enhancing the Performance and Durability of Anion Exchange Membrane Water Electrolysis via Atmospheric Pressure Plasma Jet Treatment on Ni-Co-MOF/CP	Zhi-Hui Pu
PC-D03	0038	Bimetallic Nanoparticles for biosensor applications	Karuna Gaur

PC-D04	0042	DC-pulse atmospheric-pressure plasma jet (APPJ) processed electrochemically deposited NiFe/carbon paper (CP) for anion exchange membrane water electrolysis (AEMWE)	Shuo-En Yu
PC-D05	0043	Application of Ar and O2 Microwave Plasma-Treated Electrodeposited Iron-Cobalt Electrocatalysts/Titanium Fiber Paper for Oxygen Evolution Reaction in Alkaline Water Electrolysis	Hsing-Chen Wu
PC-D06	0044	Novel Hybrid Platform Utilizing Indium Phosphate (NTOU-7) Polycrystal for Efficient Histamine Detection	Pi-Chen Wei
PC-D07	0062	Mechanism of Formic Acid Oxidation Catalyzed by $Pd_2Co_6Au_2$ Catalyst	ChiYen Peng
PC-D08	0066	Exploring Host-Dopant Interactions in Conducting Polymers to Improve Cation Removal Efficiency in Full-Polymer Electrochemical Deionization Systems	Hung-Yi Huang
PC-D09	0108	Development of Cu Nanowire modified Gas Exchange Membrane for Anti-biofouling Dissolved Oxygen sensor	Chieh Li
PC-D10	0113	Co-modulating the electronic structure and defect density of CoSe2/CeO2 nanocomposite for dual-function hydrogen oxidation and evolution reactions	Chun-Hsuan Hsu
PC-D11	0116	A Novel Zincophosphite-Based Biosensor for an Efficient Electrochemical Detection of Polyphenolic Compounds in Coffee	Yi-Rong Li
PC-D12	0133	Theoretical Insights into Iron-Doped g-C3N4 for Enhanced Electrocatalytic CO2 Reduction	Shih-Ying Yen

Date：Nov. 9th
Location：1F Hall
Posting time：10:00~16:00
Competition time：12:30~13:30

TOPIC：Batteries

Poster no.	Paper no.	Abstract	Presenter
PC-A43	0244	Simulation of mass transfer phenomenon for vanadium ions in flow channel	Zong-Min Yang
PC-A44	0247	Anisotropic Ionic Transport in PEO-Based Solid Polymer Electrolytes	Shun-Jhih Yang
PC-A45	0254	New Prelithiation Strategies of SiOx Anode by Surface Prelithiation for Improving Energy Density and High-rate	Afif Thufail
PC-A46	0266	Thermally Resilient FPI/PVDF-HFP 3D Networked Nanofiber for Advanced Lithium-Based Batteries	Zabish Bilew
PC-A47	0288	Tailoring of gold nanoparticles and pre-lithiated sulfonic acid group on functionalized boron-doped silicon as anode for high-energy-density lithium-ion batteries	Sanjana K.
PC-A48	0298	Effective Li2TiSiO5/C composite anodes for Li-Ion batteries using polyvinylpyrrolidone-assisted sol-gel synthesis	Yosephine Intan Ayuningtyas
PC-A49	0303	Porosity and Tortuosity Analysis on Composite Cathode for All-Solid-State Battery By Impedance Spectroscopy and CT Scan	Han-Pin, Hsieh
PC-A50	0306	A Freestanding CNT/Si Composite Anode with Chemically Modified Graphene Oxide Integration for Lithium-ion Batteries	Thao Nguyen

PC-A51	0322	High-Performance Near-Neutral Zinc-Air Batteries Enabled By One-Step Electrochemical Pre-Treatment	曾楷祐
PC-A52	0335	Electrospun PVDF Separator Electrochemical Characteristics Analysis	Bai Tai Liu

TOPIC：Fast Energy Storage Materials and Devices

Poster no.	Paper no.	Abstract	Presenter
PC-C11	0223	A Novel Efficient Three-stage Electrochemical Pre-lithiation method for the Amorphous Carbon Negative Electrodes of Lithium-ion Capacitors	Yun Lin
PC-C12	0237	Hierarchical Carbon Composite Electrodes for High-Reliability Supercapacitors	NINDITA KIRANA
PC-C13	0296	Electrodeposited Co0.85Se/Ni3Se2 heterostructure as an efficient binder-free cathode for fast electrochemical energy storage devices	林敬捷
PC-C14	0299	Improved Cycling Stability of K–MnHCFe//Zn Dual-Ion Battery Using Acetamide-based Deep Eutectic Electrolyte	Zhi-Ting Huang
PC-C15	0308	Water-in-mixed salt solutions as low-cost high-voltage electrolytes for aqueous potassium-ion supercapacitors	彭啓恩
PC-C16	0321	Phase-controlled synthesis of nickel selenide nanostructures on carbon nanotubes as binder-free cathodes for high-performance hybrid supercapacitors	Bo-Chih Huang

TOPIC：Basic Electrochemistry

Poster no.	Paper no.	Abstract	Presenter

PC-D13	0136	Porous Structure Manipulation of Activated Carbon in Phase and Morphological Control-MnOx Composites for Enhanced Electrochemical Capacitive Deionization	Meng-Fei Wu
PC-D14	0142	DFT study of CuO as an Electrocatalyst for CO2 Conversion into Value-Added Product	Fu-Chi Teng
PC-D15	0150	Constructing carbonized ZIF-8@Au electrode materials for non-enzymatic electrochemical H2O2 sensing	Shih-Hao Yang
PC-D16	0151	Preparation of bismuth-tin bimetal/copper-reduced graphene oxide catalyst for electrochemical reduction of carbon dioxide to formate	Chun-Wei Huang
PC-D17	0158	In-Situ Growth of Polypyrrole Nanoarrays on Carbon Paper with Subsequent Immobilization of Glucose Oxidase for Salivary Glucose Sensing	Ching-Hao Liu
PC-D18	0166	Water-Based Conductive Ink for Handmade Carbon-Printed Electrodes to Electrochemical Biosensing of CA-125	Ching-Tzu Liu
PC-D19	0194	Exploration of Charge Transport in Electrochemical Transistors and Thim Film Batteries	羅友捷
PC-D20	0198	Construct a high-performance electrochemical deionization system for the recovery of heavy metal ions	Hsing-Mei Chou
PC-D21	0275	Synergizing Electrode Modifications and Electrochemical studies on Co-ZnO to Enhance Aqueous Organic Redox Flow Battery Efficiency	Divyavalli
PC-D22	0301	Investigation of Transition Metal Dichalcogenide Nanocomposites for the Electrochemical Detection of Dimethylamine	Yun-Cih Cai

PC-D23	0320	Hydrothermal synthesis of high-entropy alloys as electrocatalysts for high efficiency oxygen production	Chao Fang Huang
PC-D24	0327	The optimal ratio of Sn and Ir doping in Pd catalysts to enhance the catalytic effect for formic acid oxidation	Chieh-Lin Chiang
PC-D25	0018	Metal-Organic Framework-Derived Trimetallic Sulfides Applied to Electrochemical Water Splitting	Zhen-Chi Liao

Poster Exhibition

Date：Nov. 8th
Location：2F Gallery
Posting time：10:00~17:00

TOPIC：Batteries

Poster no.	Paper no.	Abstract	Presenter
PO-A01	0001	Fabrication of nanoporous electrospun PtNi nanowires and their application as electrocatalyst for PEMFC	Ting Jui Chen
PO-A02	0002	Fabrication of nanoporous electrospun PtFe nanowires and their application as electrocatalyst for PEMFC	Lu Wet Te
PO-A03	0003	High Energy Density and High Safety Lithium-ion Pouch Cells	Jyu-Lum Yan
PO-A04	0024	Silicon/hard carbon composites derived from phenolic resin as anode materials for lithium-ion batteries	Wei-Ren Liu
PO-A05	0039	Revealing the effect of DMSO-regulated aqueous electrolytes on the improved electrochemical stability of electrodes in zinc ion batteries	Ming Hsien Lin
PO-A06	0045	Development of Polymer-Ceramic Composite Solid Electrolytes for Lithium-ion Batteries	Keng-Hao Cheng
PO-A07	0053	Effect of modification temperature of SiOx carbon coating on electrochemical properties	Yan-Xiong Liao
PO-A08	0063	Electrochemical Investigation of Surface Modifications on Graphite Anode Materials for Lithium-Ion Batteries	林秀芬
PO-A09	0075	Functional electrolyte additives for controlling SEI growth and enhancing lithium-ion battery performance	Ming-Hua Wang
PO-A10	0099	Surface modification of 5V high-voltage	Guo-Kai Xu

		LiNi0.5Mn1.5O4 cathode materials via SWCNTs wrapping	
PO-A11	0101	Preparation of LiTa2PO8/PVDF-HFP Composite Polymer Electrolytes for All-solid-state Lithium Metal Battery	Bo-Rong Zhang
PO-A12	0102	Preparation Composite Cathode based on Single Crystal NCM811 Materials for All-Solid-State Lithium Metal Battery	Hohg-Zhi Lin
PO-A13	0107	Thermal-extrusion method for the preparation of Li1.3Al0.3Ti1.7(PO4)3 (LATP)-based composite solid electrolytes using ZIF-8 and Al-LLZO as a buffer layer between LATP/Li interface for all solid-state lithium metal batteries	Desalegn Yilma Kibret
PO-A14	0144	Functional Polymer Cathode Modification Technology	Ju-wen Chang

TOPIC：Conversions

Poster no.	Paper no.	Abstract	Presenter
PO-B01	0030	Ni-Co-Mo Oxide-Based Electrocatalysts for Simultaneous Hydrogen Evolution and Methanol Oxidation	Da-Ren Hang
PO-B02	0031	Unlocking the Potential of Cobalt Oxide through Iron Electrochemical Activation for Oxygen Evolution Reaction	Da-Ren Hang
PO-B03	0094	Ultrathin CeOx Supported Pt NPs for HER	Shen-Wei Yu
PO-B04	0141	Fabrication and Characterization of Copper-Based Nanofibers for Electrocatalytic Reduction of Carbon Dioxide	Jia-Ru Lin
PO-B05	0159	Forming an electrochemical sensor by integrating molybdenum diselenide with vertically aligned carbon nanotubes	Lei Hu
PO-B06	0241	Regulating the Composition and Structure of Iridium/Iridium Oxide	Yo-Yuan Gu

		Nanofibers: Their Impact on Electrochemical Activity and Application in Hydrogen Peroxide Sensors	
PO-B07	0248	First-Principles Study of Band Offsets at AgzCu1-zIn1-xGax(Se1-ySy)2/CdS Heterointerfaces for Photovoltaic Applications	Ngoc Thanh Thuy Tran
PO-B08	0286	Investigation of an Intelligent Power Conversion System for Battery Energy Storage Systems	Chao-Tsung Ma
PO-B09	0287	Development of a Two-Stage Multifunctional EV Battery Charging System	Chao-Tsung Ma
PO-B10	0291	Study on the hydrogen evolution reaction of preparing metal-glycerate high-entropy alloys.	Chen-Xi Hu
PO-B11	0300	Mild Synthesis Approach to $Co_{1-x}Fe_x(OH)_2\text{-}SO_4$ Nanosheets with Optimized OER Catalytic Activity	Chen-Yu Wu
PO-B12	0310	An Economically Efficient Nickel-Iron Electrocatalyst for Alkaline Hydrogen Evolution Reaction Hydrothermal Method on Foam Nickel at Constant Potential	Mengyao Gao
PO-B13	0311	Upcycling of waste Lithium Iron Phosphate from Spent Lithium-Ion Batteries into electrocatalysts for hydrogen evolution reaction: A strategy to turn the trash into treasure	Jing-Xian Chen
PO-B14	0324	Use of Electrochemical Intercalation in Preparation of Expanded Graphite	Ting-Li Fang
PO-B15	0325	Harnessing Ni SACs on cogently designed S-doped nanofiber-based catalysts for selective CO2 electroreduction	Varad Modak

TOPIC：Photoelectrochemistry/Electroplating

Poster no.	Paper no.	Abstract	Presenter
PO-E01	0077	The Effect of Contact Pin on the uniformity of Copper Deposition in Electroplating with Numerical Model	YiLun Hung
PO-E02	0079	A Cu-Cu Direct Bonding Method by Using Cu Particle	Chun-Wei Chiang
PO-E03	0222	Size-controlled synthesis in titanium nanoparticle/graphene oxide nanoribbon composites for ractopamine detection	Chia-Liang Sun
PO-E04	0271	Enhancing the Photoelectrochemical Properties of Bi2O3-ZnO Nanocomposite Layers Through Oxygen Vacancy Engineering	Po-Hsiang Wang
PO-E05	0280	SPR-Enhanced Pt@SiC Nanozyme and its'catalyzation of TMB	Yu-Cheng Lu
PO-E06	0314	Synergistic Effect of Water and Oxygen on Enhancing Stability and Open-Circuit Voltage in $CsPbI_2Br$ Perovskite Solar Cells	Chih-Ching Kuo
PO-E07	0315	Enhancing Stability and Efficiency in n-i-p Perovskite Solar Cells Using D-A Copolymers Hole Transport Layers and MeO-2PACZ/MoO3 Interface Engineering	Cheng-Yan Song
PO-E08	0329	Cobalt Doped V2O5 Thin Film as an Ionic Storage Layer for Electrochromic Application	Tien-Chai Lin
PO-E09	0350	Warpage Reduction of Electroplated Cu Foils through Nucleation/Growth Modification using Polymer Additives	Hung-Chun Chen

Date：Nov. 9th
Location：2F Gallery
Posting time：10:00~16:00

TOPIC：Batteries

Poster no.	Paper no.	Abstract	Presenter
PO-A14	0128	Effective Electrochemical Study of Optimized LiFePO4 Composite Cathode for all-solid-state Li-metal Battery	Yin-Li Wang
PO-A15	0134	Surface Modification of Current Collectors to Enhance the Cycling Efficiency of Anode-Free Lithium-Ion Batteries	Jui-Hung Chen
PO-A16	0140	Establishment of Graphene Process Flow for SiOx-C Anode Adhesion Improvement	Chun-Hao Huang
PO-A17	0155	Recovery of Vanadium from Waste Aqueous Zinc-ion Batteries	Hsing-Kai Tseng
PO-A18	0169	Effect of Lithium Carbonate on Properties of Nickel-Rich Cathode Materials	Yu-Hsuan Chen
PO-A19	0221	Influence of Processing Techniques on Crystallinity and Performance of Ni-rich Layered Oxides Cathode	Yu-Fan Chen
PO-A20	0224	Converting waste phenolic resin into hard carbon as anode materials for high-performance sodium-ion batteries	Yao-Yang Chang
PO-A21	0226	Morphology-Dependent Electrochemical Performance of High-Entropy Oxide Anodes for Lithium-Ion Batteries	Ananya Panda
PO-A22	0235	Synthesis of Quaternary Ni-rich NCMA Layered Cathode via Solid State Reaction	ying-yi chen
PO-A23	0240	Novel Application of LiVPO4F as the Cathode Material for Anode-free Hybrid	Yu-Chun Huang

		Lithium/Sodium Metal Batteries	
PO-A24	0242	Effect of Na Content on Electrochemical Behavior of NaxMnO2 Layered Cathodes based on Defect Chemistry Consideration	卓薰雅
PO-A25	0249	Preparation of Nickel-Rich LiNi0.8Co0.15Al0.05O2 (NCA) Composite Cathode via Novel Deposition Method	Ray-Rong Tang
PO-A26	0253	Low iron ion impurity electrolyte and high electrode active catalysts for vanadium redox flow battery	Chia-Hung Yeh
PO-A27	0264	Safety evaluation of commercial lithium-ion battery separators	Yan-Heng Wu
PO-A28	0307	Spherical Graphene Microstructures on Battery Separators: Boosting Li-S Cell Efficiency	Thi Ai Ngoc Bui1
PO-A29	0326	Capacity-Enhanced Thick Li4Ti5O12 (LTO) Electrodes Prepared by Partial Densification Process	Ze-Ren Jhang
PO-A30	0328	Machine-Learning Assisted Analysis on the Transport Behavior of Zn2+ in Room-Temperature Ionic Liquid Electrolytes	Minjoon Hong
PO-A31	0349	Regulating Li deposition with different morphology of fibers	Ai Ling Huang

TOPIC：Fast Energy Storage Materials and Devices

Poster no.	Paper no.	Abstract	Presenter
PO-C01	0040	The application of niobium oxide and reduced graphene oxide composite electrodes in supercapacitors	Yang-Ming Lu
PO-C02	0119	Using 2D Molybdenum disulfide to improve the supercapacitor properties of copper oxide	Yang-Ming Lu
PO-C03	0127	Investigation of the Effect of Different	Yang-Ming Lu

		Copper Oxide Morphologies on Supercapacitor Performance	
PO-C04	0276	Design of a Battery Management System for Electric Stackers Based on NUVOTON Cortex-M4	Chun Kai Hung
PO-C05	0294	Development of methyl urea-based deep eutectic solvents for high-performance zin-ion batteries based on polyaniline/graphene nanofiber composite cathodes	Jeng-Yu

TOPIC：Basic Electrochemistry

Poster no.	Paper no.	Abstract	Presenter
PO-D01	0023	Effect of Temperature on Electrochemical Kinetics for Positive Electrodes of Vanadium Flow Batteries	Kuan-Yu Pan
PO-D02	0029	Comparison of Corrosion Kinetics of Copper and Cobalt in CMP Slurries with Different Organic Complexing Agents	Pei Huan Hsueh
PO-D03	0076	Spontaneous Reduction of Gold (III) on Fe and Pyrrolic-N-Co Doped Nanoporous Carbon from ZIF-8 for Electrochemical Immunosensing of CA-125	Nattharika Runprapan
PO-D04	0084	Sensing Performance of EGFET pH Sensors with $ZnWO_4$ Membrane Fabricated on Glass Substrate	You-Kai Wu
PO-D05	0086	Performance of an AlInGaO Extended-Gate Field-Effect Transistor pH Sensor	Jia-Hua Wu
PO-D06	0095	Property of Sensitivity pH sensor based on InHfGaO via Annealing	Yen-Fu Chen
PO-D07	0163	The influence of ternary metal oxide with waste sponge composite for electrocatalytic in alkaline water electrolysis	陳彥瑋
PO-D08	0231	Tuning Palladium with Heteroatom-Rich	ENDALKACHEW

		Ligands in Homoleptic and Heteroleptic Coordination Spheres for Enhanced Electrochemical Hydrogen Peroxide Production	ASEFA MOGES
PO-D09	0277	Enhancement of electrochemical activities using Au@MOF as a substrate for vibrio harveyi bacteria detection	Rajesh kumar Raghav
PO-D10	0292	Electrochemical Synthesis of Pd-Ni Nano-dendrites Heterostructure for Nonenzymatic Glucose Detection	Yang-Sheng Lu
PO-D11	0312	Immobilization of MIL-100(Fe) Metal-Organic Framework on a PEDOT Modified Electrode to Enhance the Detection of Tartrazine	Shao-Yang Wu
PO-D12	0318	Modification of pencil lead with conductive PEDOT to enhance the selectivity for sensing hydroquinone, resorcinol, and bisphenol	Chih-Yu Lin

Paper abstract collection

Abstract No. 0001 Ting Jui Chen

The chemical dealloying method [1] aims to enhance the platinum ratio by using sulfuric acid to remove more nickel metal, thus forming numerous pores to increase the reactive surface area. SEM imaging was used to observe the dealloying process from 0 to 6 hours, showing in Figure 1. It was observed that after 6 hours of dealloying, pores appeared in the fibers, with the average diameter reduced to 27±4 nm, proving the effectiveness of 0.1 M sulfuric acid. The optimal parameter was determined to be 6 hours of chemical dealloying method. Further electrochemical tests on the fibers, including Cyclic Voltammetry (CV), Linear Sweep Voltammetry (LSV), and Accelerate Degradation Test (ADT), revealed that the maximum current density in the CV curve was 1.3 mA/cm2, with an ECSA of 110.6 m2gmetal-1. The LSV curve showed a limiting current of -4.9 mA/cm2 and a half-wave potential of 0.86 V, indicating better electrochemical activity compared to commercial Pt/C. ADT tests is shown in Figure 2 that after 3000 cycles, the ECSA decayed by 13.6 %, Is decayed by 21% , and the half-wave potential decayed by 3.9% , all of which were less than that of Pt/C, meeting the ideal expectations of this experiment.

Abstract No. 0002 Lu Wet Te

In this study, platinum-iron polymer nanofibers were fabricated using electrospinning. The polymer solution was prepared with 2wt% metal salt, 8wt% PVP, and 8g methanol, achieving a molar ratio of 1:5. The electrospinning conditions were: needle inner diameter of 0.18mm, collection distance of 8cm, temperature of 30-40°C, humidity below 40%, and an electric field of 10kV. The average fiber diameter was 46±6nm. The fibers were soaked in 0.5M sulfuric acid solution at 40°C for 2 hours and 4 hours.As shown in Figure 1 (a), (b), (c) are SEM images at 100k magnification for 0 hours, 2 hours, and 4 hours, respectively. After 2 hours of dealloying, small white pores appeared on the fibers, and the pores became larger after 4 hours. SEM images at 30k magnification, measured with ImageJ, showed that the fiber diameter decreased over time and the diameter distribution became more concentrated with dealloying time.

EDS spectra indicated that the platinum to iron ratio changed from 17.18:82.82 (matching the preset 1:5 ratio) at 0 hours to 46.04:53.96 (1:1 ratio) after 2 hours, and to 63.29:36.71 (2:1 ratio) after 4 hours, showing that iron was corroded and dissolved. XRD spectra showed that the fibers formed an alloy before and after dealloying, with iron peaks decreasing over time, especially noticeable after 4 hours.CV and LSV graphs indicated that the ECSA[1] increased from 3.8 m^2/ g-1 to 144.5 m^2/ g-1 after 4 hours of dealloying, the limiting current increased from 3.8 mA/cm^2 to 4.91 mA/cm^2, and the half-wave potential increased from 0.6V to 0.9V. After 3000 cycles, the ECSA decreased to 127.3 m^2/g-1, with a degradation rate of 11%, and the half-wave potential decreased to 0.8V, with a degradation rate of 0.8%, demonstrating sufficient durability of the electrochemical performance.

Conclusion: Dealloying enhanced the electrochemical activity and stability of the platinum-iron nanofibers, demonstrating potential application value.

Abstract No. 0003 Jyu-Lum Yan

Lithium-ion batteries have been developed for more than 30 years and are used in a wide variety of fields, industries and products. In addition to general 3C, in the past years, the focus has been on the application of electric-vehicles batteries and electricity storage systems. . However, how to achieve the high energy density and have high safety is the most difficult subject in the development of lithium-ion battery technology.

This research induces the high-safety gel electrolyte, and introduces high-energy cathode materials (high nickel NMC622) and our company's (CPC) carbon anode materials (soft carbon/graphite) to prepare pouch cells with a capacity greater than 1Ah through the production line of a battery factory. Compared with the lithium-ion batteries which use commercial liquid electrolyte, our pouch cells not only has excellent electrical performance, including high capacitance, high C-rate charge and discharge performance and long cycle life, it also passed SAE:J2464 nail penetration which show the high safety. Therefore, this research and development can provide a commercial pouch cells with high safety, high electrical performance and suitable for today's lithium-ion battery manufacturing line. It also provide some ways to solve the safety issues in the lithium battery industry.

Abstract No. 0004 Aninda Jiban Bhattacharyya

This lecture will focus on an important class of "post Li-ion batteries", viz. the multivalent rechargeable aqueous batteries. As water is the solvent, aqueous rechargeable batteries do not require a sophisticated cell assembly line, like that of the non-aqueous batteries. One of the significant challenges that hinder their wide-scale application is the availability of suitable electrode materials that can work in the aqueous electrolytes. In this lecture, I will discuss a few examples of aqueous batteries focusing on the diverse intricacies related to materials, [1, 2] electrochemical and energy storage characteristics [1-3] of various multivalent aqueous battery systems. [5, 6] The energy storage mechanism will be discussed in the context of the findings from both experiment and theory.

1. Probing the Na+/Li+-ions Insertion Mechanism in an Aqueous Mixed-Ion Rechargeable Batteries with NASICON-NaTi2(PO4)3 Anode and Olivine-LiFePO4 Cathode, Akshatha Venkatesha, Deepak Seth, Rahul Mahavir Varma, Suman Das, Manish Agarwal, M. Ali Haider, Aninda J. Bhattacharyya ChemElectroChem 2023, 10, e202201013.
2. A Redox-Active 2 D Covalent Organic Framework as a Cathode in an Aqueous Mixed-Ion Electrolyte Zn-Ion Battery: Experimental and Theoretical Investigations, Akshatha Venkatesha, Ruth Gomes, Anjali S. Nair, Saumyak Mukherjee, Biman Bagchi, and Aninda J. Bhattacharyya ACS Sustainable Chem. Eng. 2022, 10, 6205-6216.
3. Exploring Cu-Doped Co3O4 Bifunctional Oxygen Electrocatalysts for Aqueous Zn-Air Batteries, Asutosh Behera, Deepak Seth, Manish Agarwal, M. Ali Haider, and Aninda Jiban Bhattacharyya, ACS Appl. Mater. Interfaces 2024, 16, 17574-17586.
4. Exploring Cation-Deficient Magnetite as a Cathode for Zinc-ion Aqueous Batteries, Akshatha Venkatesha, Gowra Raghupathy Dillip, Tanmay Mohan Bhagwat, Sayak Mandal, Rekha Kumari, Martin Etter, Gopalakrishnan Sai Gautam, Aninda J. Bhattacharyya, ACS Sustainable Chem. Eng. 2024 (under revision).
5. Exploring Aluminum-ion (Al3+) Insertion in Ammonium Vanadium Bronze (NH4V4O10) for Aqueous Rechargeable Batteries, Vishnu Priya Haveri Radhakantha, Shristi Pradhan, and Aninda J. Bhattacharyya, J. Electrochem. Soc. 2024 (manuscript under preparation).
6. A. Venkatesha, M. Sanawa, Aninda J. Bhattacharyya, Probing the Ca2+-insertion-Induced Structural Transitions in Molybdite Cathode for Aqueous Rechargeable Calcium-Ion Battery (manuscript under preparation).

Abstract No. 0005 **Yu-Jen Shih**

A heterostructure of spinel series iron oxides combined with TiO_2 nanotube arrays, $(MFe)_x$/TNTA (M = Fe, Ni, Zn, Co, Cu), is synthesized through solvothermal methods. The performance of $(MFe)_x$/TNTA as PEC photoanode is examined in acetaminophen (APAP) degradation and hydrogen generation. The material properties are analyzed using cyclic voltammetry, photocurrent, impedance, and Mott-Schottky analysis. The APAP removal rate and the hydrogen production rate are tested under various experimental conditions, including pH values (3 - 11), initial APAP concentrations (2 – 50 mg/L), PEC electrolysis conditions (0 – +1.2 V vs. RHE), and charge carrier trapping agents. Results show that among spinel ferrites $NiFe_2O_4$ based heterostructure is a visible light-driven photocatalyst, which achieves over 95% APAP removal efficiency under an applied bias of +1.2 V vs. RHE, corresponding to a hydrogen production rate of 2.8 μmol/cm2/h on the PtC cathode. The photoanode $(NiFe)_{1.5}$rGO/TNTA, with a loading of 1.5 μg/cm2 $NiFe_2O_4$ and 2 μg/cm2 rGO, demonstrates optimal applied bias photon-to-current efficiency (ABPE) and incident photoncurrent conversion efficiency (IPCE) of 0.95% (+0.7 V) and 16.1%, respectively. The light excitation wavelength range covers up to visible light at 470 nm.

Abstract No. 0006 **Leigh Aldous**

Harnessing low-grade heat from sources such as industrial processes, solar irradiation and body heat represents a significant opportunity for sustainable energy conversion. However, converting low-grade heat (<100°C) with minor temperature gradients (e.g. 1 to 20°C) remains challenging. Applying thermoelectrochemistry in 'thermogalvanic devices' is gaining increased attention for converting this heat, especially as alternatives to thermoelectric devices. These devices convert temperature gradients into electricity using two electrodes and a shared liquid or gelled electrolyte.

This presentation will introduce this emerging field, using my research as a case study. These devices operate based upon the entropy difference between the oxidized and reduced states of a redox couple, and their performance can be modeled using a modified Butler-Volmer equation.[1] Constructing devices requires two electrolytes with opposite entropy profiles,[2] and have demonstrated their capability to power devices using body heat.[3] However, the literature contains a variety of measurement techniques for both electrical power[4] and efficiency,[5] many of which yield inconsistent results. Despite these challenges, the future looks promising for thermogalvanics to introduce new cost effective low-grade heat harvesting options.

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Abstract No. 0007 Chung-Wei Kung

Given several advantages of metal–organic frameworks (MOFs) including regular porosity, ultrahigh specific surface area, and periodic intra-framework functionality, MOFs have been considered as desirable materials for various electrochemical applications including electrocatalysis, electroanalysis, and energy storage. However, the electrically insulating nature and poor chemical stability of most MOFs strongly limit the use of MOFs in these applications. Cerium(IV)-based MOFs (Ce-MOFs) thus become attractive candidates for these purposes owing to their chemical stability in water as well as their redox activity that may allow the charge transport via redox-hopping pathways in aqueous electrolytes.

In 2021, our group reported the first example investigating the redox-based electrochemistry of Ce-MOFs in aqueous electrolytes [1]. Later studies from our groups published in 2021-2024 thus attempted to utilize Ce-MOFs and their nanocomposites in a range of electrochemical applications, including supercapacitors [1-3] and electrochemical sensors [4]. In this talk, the development of Ce-MOF-based materials for these electrochemical applications done by our group will be highlighted.

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Abstract No. 0009 Yan-Gu Lin

The energy transition is one of today's greatest societal challenges. Electrocatalyst materials, central to electrochemical energy conversion devices like fuel cells and water electrolyzers, are expected to play an increasingly crucial role in the near future. To enable the widespread adoption of electrochemical systems, the urgent challenge in developing electrocatalyst materials is achieving a combination of high activity and long-term stability at low cost. Despite the variety in electrocatalyst materials, driven by the different types of electrochemical systems (such as noble vs. non-noble metals in acidic vs. alkaline media) and the specific requirements of various electrochemical processes (oxidation or reduction reactions of different species at varying electrode potentials), the activity and stability properties of electrocatalysts largely depend on their (surface) chemistry and structure. These properties, and their changes over time, can be directly studied using in situ or operando synchrotron X-ray techniques. This presentation will highlight the versatility of these techniques in addressing key challenges in electrocatalyst materials development, particularly by examining adsorption and oxidation trends.

Abstract No. 0010 **Chia-Ying Chiang**

As the climate change, energy independence, and environment sustainability are gaining more and more attention, recent advancements of energy development have led to paradigm shift from petroleum-based to bio-based renewable sources.

Biodiesel is one of the widely known renewable energy. In the synthesis process, 10~20% of by-product (waste), glycerol, is produced, leading to a serious oversupply, and it even is targeted by US Department of Energy (DOE) as the key chemical which should be upcycled. However, due to its extremely viscous property, i.e. higher than 1300 cp at room temperature and flowing like a glue, the purification can only be done by either distillation and/or in a high temperature vacuum system which both are energy and cost intensive industrial processes. With renewable energy production at low cost is the key in mind, an approach to directly convert this waste solution plays a core for our greener future. Similar issue is also found in the upcycling or reaction of hydroxymethylfurfural (HMF), the key intermediate in the production of biomass derived fuels and polymer. At high concentration, it is viscous and temperature sensitive, so most of the traditional chemical processes which rely on high temperature and pressure can't be used.

Electrochemical reaction can be easily adopted to resolve this issue and even more, a surprising benefit can be obtained simultaneously from the electro-oxidation of biomass (like glycerol or HMF) included aqueous solution – green hydrogen production from water reduction at the cathode with much lower energy consumption comparing to the pure water splitting reaction! With integrating of water reduction and biomass oxidation together, we can not only reduce the green hydrogen production energy but also can increase the profit for the bio-industries! This talk, a blueprint for the sustainable bio-industrial waste upcycling and green hydrogen production will be carefully addressed.

Abstract No. 0011 **Tzu-Ho Wu**

Urea electrolysis has gained increasing attention recently, because it can cost-effectively produce ultrapure hydrogen by coupling with urea oxidation reaction (UOR). Compared with water electrolysis, it has a lower cell potential and hence low energy consumption for hydrogen production [1]. Nickel hydroxide is the most commonly used catalyst for UOR, and it has layered structure that can accommodate versatile ions and chemical species [2]. Herein, we successfully synthesized α-Ni(OH)2 with embedded different anions, including CH3COO-, I-, NO3-, SO42-, and CO32- by polyol reaction and the subsequent ion exchange process, and the effects of preintercalated anion species on the electrocatalytic properties for UOR were probed. Our results show that the UOR performance is strongly correlated to the interlayer distance of nickel hydroxide. By embedded CH3COO-, the sample has the largest d003 of 10.39 Å, and this sample exhibits the highest catalytic current density of 14.3 mA cmECSA-2 and the lowest Tafel slope of 30 mV dec-1. As a comparison, the CO32-

preintercalated sample has the smallest d003 (8.35 Å) with inferior UOR performance (6.1 mA cmECSA-2 and 115 mV dec-1).

Abstract No. 0012 Seung-Taek Myung

Mn-based P2-Nax[LiyTM1−y]O2 cathode materials are available to reach high capacity through the combination of cationic and anionic redox in Na cells.[1] The Na–O–Li configuration induces the delivery of additional capacity assisted by the oxidation of oxygen when lone-pair electrons are formed in the O 2p orbital, provided that at least one of the following conditions is satisfied: 1) lattice oxygen evolution1 or 2) migration of the Li element to Na layers although the corresponding charge transfer is kinetically sluggish.[2] The reaction is not limited to compounds that have alkali ions in the TM layer but is also available with divalent ions; namely, the presence of Mg in the TM layer, P2-Nax[MgyMn1−y]O2 (x = ~2/3, y = ~0.28). The effect of the 4d Ru element in P2-Na0.6[Mg0.2Ru0.2Mn0.6]O2 is investigated. Ru-free Na0.6[Mg0.2Mn0.8]O2 is activated with the Mn3+/Mn4+ redox, after which the charge is compensated by the sluggish oxidation of lattice oxygen (O2−) to O2n− triggered by O2 evolution from the oxide lattice. These effects are generally unfavorable and result in poor long-term cycle stability induced by the irreversible migration of Mg2+ from the transition metal (TM) to Na layers in the P2 structural framework. Benefiting from the covalent Ru bonded with O in the TM layers, the Mg migration reversibly progresses from the TM to sodium slabs without O2 evolution in the structure.

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Abstract No. 0013 **Shien Ping Feng**

My research focuses on the development of new electrochemical technology for low-grade heat recovery, solar and indoor light harvesting, and nanomaterial fabrication. Firstly, we invented a new electrochemical system called the Direct Thermal Charging Cell (DTCC) for efficient conversion of low-grade heat to electricity [1]. The system utilizes asymmetric electrodes, with a graphene oxide/platinum nanoparticles cathode and a polyaniline anode, in an aqueous Fe2+/Fe3+ redox electrolyte, enabling efficient conversion of low-grade heat to electricity. Continuous energy conversion is achieved through isothermal heating during the charge and discharge process. The system can self-regenerate upon cooling, allowing for device cyclability. This invention has transitioned from academic research to real-world applications in various fields, such as HVAC and self-powered smart windows. Secondly, we developed a living passivation strategy using a hindered urea/thiocarbamate bond Lewis acid-base material (HUBLA) [2]. This strategy employs dynamic covalent bonds with water and heat-activated characteristics to dynamically heal perovskite materials, ensuring device performance and stability. When exposed to moisture or heat, HUBLA generates new agents that further passivate defects in the perovskite. This innovative coating functions similarly to sustained-release capsules in drugs, continuously releasing chemicals to heal defects caused by environmental stressors like water and heat. It shows great promise for next-generation perovskite photovoltaics. Currently, our team is collaborating with industry partners to apply this technology in large-scale perovskite solar panels. Lastly, we developed effective additives for the fabrication of nanocrystalline copper with uniform nanograin sizes and low impurity levels, which enables fast grain growth and facilitates cross-interface Cu-to-Cu bonding at low temperatures [3]. The combination of a low thermal budget and superior bonding quality offers a promising approach for the development of fast and low-temperature bonding processes for advanced electronic and 3DIC packaging applications.

Abstract No. 0014 **Cheng-En Ho**

The developments of internet of things (IoT), internet of vehicles (IoV), and artificial intelligence (AI) technologies rely on ultra-reliable, low latency, and massive capacity of network communications. In the high-frequency/speed signal transmission, the surface roughness of build-up circuit layers resulting from the semi-additive process (SAP) can cause noticeable signal scattering phenomenon, degrading the signal transmission performance; consequently, low-roughness Ajinomoto build-up film (ABF) are now favored for high-frequency applications and fine-line fabrication. In this study, we established correlation between electroplated Cu crystallographic microstructure and ABF substrate roughness through using a transmission electron microscopy (TEM), and scanning electron microscope (SEM) in conjunction with electron backscatter diffraction (EBSD). The research results showed that a low-roughness substrate might yield less Cu twin boundaries (TBs) with smaller grain sizes, leading to the undesired pinhole formation in the subsequent chemical etching process. We proposed a method that enables to deposit appropriate electroplated Cu microstructure through an annealing treatment combined with adjustment of plating current density, thereby preventing the undesired pinhole formation over the low-roughness ABF substrate. The findings of the present study advanced our understandings of the substrate roughness effect on the Cu microstructure and pinhole formation, which are very beneficial to the SAP applications and will be helpful in development of the high-frequency/speed transmission technologies.

Abstract No. 0015 Hnin Yin Yin Nyein

In this talk, I will present our recent progresses on the development of wearable biosensors toward remote ambulatory care and routine health monitoring. Today's healthcare system majorly relies on centralized facilities, leading to hindrance in timely medical diagnosis and treatment. Our wearables aim to address this limitation by enabling non-invasive, continuous detection of clinically meaningful biomarkers in better accessible dermal fluids. These sensors integrate flexible electronics and solid-state electrochemical sensors in a single robust platform such that biochemical analysis can be done effortlessly at the dermal site of sample collection. I will introduce how we tackle the key challenges in current wearable technology to achieve reliable analyte quantifications comparable to standard measures via carefully-devised electrochemical sensors suitable for wearables. These wearables enable dermal fluids a viable mode of health monitoring at the molecular level across activities, whether active or sedentary, and across user groups, whether young or old, healthy or ill. By using the sensors, continuous molecular analysis can be utilized for investigations of body's endogenous and stimulated response relates to stress, metabolic conditions, and potentially neurological afflictions.

Abstract No. 0016 Tzu Chien Wei

"Solar cells are a crucial technological tool for humanity to achieve the 2050 net-zero target. Taiwan, situated in the subtropical region, receives abundant sunlight, making it highly suitable for solar photovoltaic development. By 2023, Taiwan had installed over 12 GW of solar capacity. However, due to its limited land area and high population density, Taiwan faces significant challenges in further expanding its solar capacity. It is suggested to actively develop next-generation solar cell technologies, leveraging advanced technology to maximize land use efficiency and to increase the electricity output per unit of land area. This approach is deemed necessary to meet the targets of 31 GW by 2030 and over 40 GW by 2050. These next-generation solar technologies includes tandem photovoltaics, solar cells with high capacity factors and photovoltaic technologies for emerging installation fields.

Abstract No. 0017 I-Ming Hsing

"Infectious diseases (e.g., COVID-19) and cardiovascular diseases (CVD) are leading causes of death worldwide. Effective molecular diagnostics technologies (e.g., RT-PCR and RAT) that can be deployed at large scale setting have demonstrated its usefulness for monitoring and mitigation of SARS-CoV-2 pathogens in the community. The recent COVID pandemic has further reminded the healthcare community the imperative needs for wearable and disposable devices and technologies that can achieve non-invasive and continuous monitoring of patients to produce clinically relevant health, realizing the vision of remote ambulatory monitoring and "putting" patients at home. Leveraging on our expertise in nucleic acid engineering, I will present some of our earlier electrochemical approaches for nucleic acid based diagnostics [1] and introduce our recent work utilizing isothermal amplification and CRISPR-based strategy for the development of at-home testing disposable patch for multiplexed detection of viral pathogens (e.g., InFluA, InFluB, SARS-CoV-2).

Abstract No. 0018 Zhen-Chi Liao

"Increasing climate change and environmental issues make the development of renewable energy sources crucial. Hydrogen, which is a promising alternative to fossil fuels because its combustion only produces clean water, offering environmental benefits and high energy efficiency. One method to produce high-purity hydrogen gas is electrochemical water splitting. However, large-scale application in factories is challenging due to the high costs of commonly used catalysts like Pt/C and RuO2. Hence, developing alternative materials to these expensive noble metal catalysts is highly desirable.

Abstract No. 0019 Po-Yu Chen

By taking advantage of an anode with the catalytic activity towards oxygen evolution reaction (OER), protic ionic liquids can be developed as a sustainable system for metal electrodeposition if metal oxides are used as the metal sources [1]. Metal oxides react with the dissociable protons of the protic ionic liquids to form soluble metal species and water molecules. During the metal electrodeposition in the abovementioned system, metals are reduced at the cathode and water molecules are oxidized at the anode to produce oxygen and protons, respectively. The latter refreshes the ionic liquids by supplying protons consumed during the dissolution of metal oxides, achieving the sustainability of the electrodeposition system. This system can be utilized to recover silver from zinc/silver oxide (Ag_2O) coin batteries such as the SR626SW batteries [2]. The metallic silver produced after the batteries have been discharged can be oxidized by hydrogen peroxide (H_2O_2) to be silver ions and dissolved into the ionic liquid. Silver ions formed from both the redox between silver metal and hydrogen peroxide, and the dissolution of Ag_2O can be recovered as silver metal via electrodeposition.

Abstract No. 0020 Pitchai Chandrasekaran and

The design and synthesis of cost-effective, efficient, and durable catalysts for the water splitting and urea oxidation reactions (UOR) are crucial due to their essential role in energy conversion and storage processes. In this study, high-entropy perovskites, Sr(NiFeCoCrMn)O3 (HEP-NFCCM), were synthesised by facile sol-gel technique. Medium-entropy Sr(FeCoCrMn)O3 and low-entropy Sr(CoCrMn)O3 perovskites were also prepared using the same technique. The synthesized materials were characterized by high resolution transmission electron microscopy (HR-TEM), field emission scanning electron microscopy (FE-SEM), X-ray photoelectron spectroscopy (XPS), and X-ray diffractometer (XRD). Further, the electrocatalytic performance of HEP-NFCCM as an electrocatalyst in both water splitting and urea electrolysis in alkaline conditions was evaluated by linear sweep voltammetry (LSV), Tafel, chronopotentiometry and electrochemical impedance spectroscopy (EIS) measurements. This HEP-NFCCM material demonstrates superior efficiency in water splitting, requiring only 1.61 V to achieve a current density of 10 mA cm^{-2}. Additionally, HEP-NFCCM exhibits exceptional catalytic activity and selectivity for the urea oxidation reaction, achieving a current density of 10 mA cm^{-2} at a remarkably low potential of 0.285 V vs SCE. The stability of the synthesized HEP-NFCCM was analyzed by chronopotentiometry for 48 h at a constant current density of 10 mA cm^{-2} for both water splitting and urea oxidation reactions. The intrinsic activities like turn over frequency (TOF) and specific activity of the HEP-NFCCM were higher than other similar materials. Thus, the present study established the performance of the synthesized composite HEP-NFCCM as an efficient electrocatalyst for both overall water splitting and urea electrolysis in alkaline medium.

Abstract No. 0021 Yuh-Lang Lee

The characteristics and performances of Dye-sensitized solar cells (DSSCs) with various cell structures were reported and, furthermore, their advantages will be described. In addition, novel electrolytes containing two redox couple, Cu1+/Cu2+ and I-/I3-, were prepared and utilized as the electrolytes for DSSCs. The cell structures studied include tandem, direct-contact and monolithic structures. The tandem DSSCs were constructed by stacking two cells in series, termed as top and bottom cells. This architecture is proposed to solve the contrary effects of TiO2 film thickness of the photoelectrode on the light harvest and charge transport. By utilization two thinner cells instead of one thicker one, the cell performance can be increased. For the direct-contact structure, the photoelectrode and counter electrode are contacted directly, which is different from that of the sandwich cells with specific distances. The performance of the cell is improved due to the decrease in the charge transfer distance between the two electrodes. The result demonstrated that quasi-solid state DSSCs with a direct-contact structure achieved a notably higher PCE of 35.42% than that obtained by a sandwich-structured cell (29.86%) under 6000 lux room light condition. Regarding the monolithic structure, several cells can be connected in series on a panel to elevate the voltage of the module cells. Redox couples of Cu1+/Cu2+ or Co2+/Co3+ are recently utilized to prepare the DSSC electrolytes because the corresponding cell can get a higher potential. However, the diffusivities of these ions are lower than that of I-/I3- due to the bulky sizes of copper ions. To solve this shortage, a tiny amount of I-/I3- was added into the Cu1+/Cu2+ electrolyte system. Experimental results show that this strategy did increase the PCE of the DSSCs.

Abstract No. 0022 Kazuhiko Matsumoto

Ionic liquid electrolytes can improve the sodium metal deposition/dissolution behavior especially at high temperatures.[3] Fluorination of Al substrate along with the control of crystal orientation further increases the Na metal deposition/dissolution efficiency.[4] Introduction of β-alumina electrolyte brings out the benefit of ionic liquid electrolytes. Effects of the Na metal state are compared at 90 and 105 °C with β-alumina electrolyte, which reveals that the liquid Na metal electrode enables high rate performance and cycle life owing to the high interfacial compatibility.[5]"

Abstract No. 0023 Kuan-Yu Pan

Energy storage systems have become crucial technologies that facilitate the broader adoption of intermittent renewable energy sources such as solar panels and wind turbines. Flow batteries are promising energy storage technologies due to their long-life cycles and expandable features. Among these, the vanadium flow battery is especially notable. However, real-world applications experience significant temperature variations that affect battery performance. Characterizing the thermal parameters is essential to improve the efficiency and reliability of the flow battery. This study analyzes electrochemical kinetics of positive electrodes of vanadium flow batteries at various temperatures using cyclic voltammetry (CV) and impedance technique (Fig.1). As shown in Fig.1(a), higher temperatures increase the oxidation and reduction peak current density of VO2+ solution and enhance reversibility. Furthermore, Fig.1(b) demonstrates that higher temperatures decrease both the solution resistance and the charge transfer resistance for positive reactions. The study provides a detailed explanation of how the kinetic parameters change with varying temperatures.

Abstract No. 0024 Wei-Ren Liu

In this study, we propose carbon-silicon core-shell microspheres, HC@Si-P, for prospective anodes in LIBs. The proposed HC@Si-P microspheres consists of a hard carbon as a core and nano-silicon/pitch coating-based carbon acting as a shell. The HC@Si-P composite anode exhibits high reversible capacity and an extended cycle life. The hard carbon cores of the composites are prepared from pyrolyzed phenolic resin whereas the carbon-coated silicon shell is fabricated by a pitch coating process, which confers both high electrical conductivity and structural stability. A composition-optimized 20 wt.% pitch coated-Si/HC composite anode delivers superior cycling stability over 200 cycles at a current density of 1 A g-1, showing capacity of 398 mAh/g. At a maximum current density of 5.0 A/g during charge-discharge testing, the reversible capacity reaches 215 mAh/g. Upon reducing the current density to 0.1 A/g, the capacity remains high at 537 mAh/g. The lithium ion diffusion coefficient of HC@Si-P is also enhanced from 1.13×10-12 to 1.78×10-12 cm2/s after pitch coating. These results and way of preparation promotes a practical feasibility of high-performance Si-based Li-ion batteries applications.

Abstract No. 0025 **Yu Ting Huang**

The redistribution layer (RDL) is a critical component in advanced IC packaging, including fan-out and 2.5D/3D integration, as it enables the fanning out of circuits to achieve higher interconnect density. As device density continues to rise, the RDL's critical dimension (CD) and pitch must shrink accordingly. During RDL circuit fabrication, the etching process is necessary to remove the exposed sputtered seed layer, which may include copper (Cu) or titanium (Ti). However, this process inevitably etches and roughens the Cu surface of the RDL. As the post-plating resting time (q-time) increases, the Cu surface oxidizes, resulting in even greater surface roughness after etching. This roughness can lead to higher contact resistance and increased electromigration risks, particularly as the RDL linewidth becomes narrower. This work introduces a composite Cu structure that combines fine grains and nanotwins, providing structural stability and effectively resisting surface damage even after prolonged periods. This innovative approach offers a promising solution for achieving finer RDLs in advanced packaging technologies, including fan-out, while extending the electromigration lifetime beyond that of conventional coarse-grain lines.

Abstract No. 0026 **Mulayam Singh Gaur**

Research into the large-scale synthesis of 2D nanomaterials, doping and integrating monolayers, and developing unique materials with excellent properties has gained significant interest. Graphene-based 2D nanomaterials, known for their fascinating properties, are especially promising for biosensors. Most carbon-based materials use 2D graphene, fitting well within fullerenes and 1D nanomaterials. Graphene is thus central to many carbon-based materials. This presentation encourages future researchers to explore graphene-based 2D nanomaterials, aiming to discover new, cost-effective applications. It provides an in-depth analysis, focusing on unexplored research areas and the use of electrochemical impedance spectroscopy with graphene/aptamer modified glassy carbon electrodes for detecting heavy metals. The main challenge remains the real-world application of these biosensors in analyzing actual samples and targets.

Abstract No. 0027 Jian-Zhang Chen

Atmospheric pressure plasma (APP) can be operated without a vacuum system, which is costly and requires routine maintenance. It is therefore a cost-effective plasma technology. In some scenarios, when a vacuum environment is not viable, APP technology becomes the solution for certain applications such as plasma agriculture or plasma medicine. The design of APP is versatile; different types of APPs can have different reactivity and heavy particle temperatures, rendering them suitable for various applications. For APPs with heavy particle temperatures of several hundred degrees Celsius, the synergistic effect of heat and reactive plasma species makes ultrafast material processing possible. It can be applied as a rapid thermal annealing tool with the effect of reactive plasma species. For this type of ultrafast material processing, the energy consumption is about one-third to one-fifth that of a conventional furnace. For near-room-temperature or room-temperature APPs like dielectric barrier discharge jets (DBDjets), the heavy particle temperature is lower and can be applied to the surface modification of temperature-sensitive materials. In this talk, I will first introduce the basics of plasma and various types of APPs. Next, the application of APPs for ultrafast fabrication and post-modification of supercapacitor electrodes will be discussed.

Abstract No. 0028 Yi-Ting Hsieh

"Molecularly imprinted polymers (MIPs) are synthetic materials that mimic the lock-and-key mechanism found in antigen-antibody systems, offering a highly selective recognition capability for their target molecules. These polymers are created by polymerizing functional monomers and crosslinking agents in the presence of a template molecule, resulting in specific binding sites that match the template's spatial configuration. MIPs, composed of non-biological materials, exhibit greater versatility than biological systems, as they can function in extreme environments, including high temperatures and pressures. This flexibility makes MIPs suitable for various applications, such as drug delivery, chromatography, and sensor integration. However, the conventional surface molecular imprinting technique has certain drawbacks. Some reagents used in MIP synthesis pose health risks, and elevated temperatures during the process may cause the decomposition of initiators, potentially compromising the polymer's integrity. Deep eutectic solvents (DESs), composed of hydrogen bond donors (HBD) and acceptors (HBA) in specific molar ratios, are considered cost-effective and environmentally friendly solvents due to their simple synthesis and low cost. Research has shown that DESs can play multiple roles in synthesizing molecularly imprinted polymers, serving as functional monomers, cross-linkers, and porogenic solvents. In this study, DES-MIP-modified electrodes were prepared from various deep eutectic solvents. This research focuses on developing MIP electrodes to create electrochemical sensors. The resulting MIP electrodes are characterized for their morphology and composition using scanning electron microscope (SEM), energy dispersive X-ray spectroscopy (EDX), and Fourier-transform infrared spectroscopy (FT-IR). Furthermore, their electrochemical properties are examined through cyclic voltammetry (CV)."

Abstract No. 0029 Pei Huan Hsueh

Cobalt (Co) is identified as the new generation barrier material for copper (Cu) interconnection due to its low resistivity, excellent step coverage, and good adhesion to Cu. However, galvanic corrosion between Cu and Co during CMP decreases the planarization of multilayer wiring, resulting in reduced reliability of the device. Some complexing agents in slurries have been reported to moderate the difference in electrochemical action between metals [1]. In this study, the corrosion kinetics of Cu and Co in H2O2-based slurries with urea, glycine, or acetic acid were analyzed using electrochemical techniques. Figure 1 shows the Tafel and Nyquist plots of Cu and Co in H2O2-based slurries with different organic complexing agents. The corrosion potential and the charge transfer resistance of Co increased with the number of NH2-groups in organic agents, but those of Cu did not change so obviously. The study provides a detailed discussion of the corrosion kinetics of Cu and Co CMP with different organic complexing agents.

Abstract No. 0030 Da-Ren Hang

Hydrogen, a clean and sustainable energy carrier, is essential for mitigating climate change and transitioning to a low-carbon economy. Electrochemical water splitting offers a promising pathway for hydrogen production, but its practical application is hindered by the sluggish kinetics of the oxygen evolution reaction (OER). Coupling the hydrogen evolution reaction (HER) with the methanol oxidation reaction (MOR) can potentially overcome this challenge by reducing energy consumption and enhancing overall system efficiency [1]. This study focuses on the development of trimetallic and bimetallic oxide alloys based on nickel, cobalt, and molybdenum as electrocatalysts for this coupled system. These materials were synthesized through a solvothermal method and characterized using advanced techniques such as X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), and field emission transmission electron microscopy (FETEM) to elucidate their structural and morphological properties. The electrocatalytic performance of the synthesized materials towards HER and MOR was evaluated using a three-electrode electrochemical system. Detailed analysis, including linear sweep voltammetry, electrochemical impedance spectroscopy, and Tafel plot measurements, was conducted to investigate the relationship between catalyst composition and electrocatalytic activity. By understanding the synergistic effects among Ni, Co, and Mo, this research aims to optimize catalyst design for efficient hydrogen production from methanol. This work contributes to the advancement of clean energy technologies and provides valuable insights into the development of multifunctional electrocatalysts for sustainable energy conversion.

Abstract No. 0031 Da-Ren Hang

The electrochemical oxygen evolution reaction (OER) plays a pivotal role in numerous energy conversion and storage technologies. In this study, we present a unique strategy that significantly enhances the OER activity of cobalt oxide (CoO) catalysts through iron (Fe) activation. Comprehensive characterizations were conducted to understand the relationship between structure, composition, electronic configuration, and their collective impact on catalytic performance. Our findings demonstrate the crucial role of annealing in regulating CoO's morphology and microstructure, which in turn dictates its inherent OER activity. Two CoO samples were subjected to distinct annealing temperatures, specifically 700°C and 900°C. Notably, the less porous sample (700°C annealed) demonstrated superior performance in the OER compared to its highly annealed counterpart (900°C). This underscores the intricate relationship between microstructure and electrocatalytic efficacy. The unmodified CoO sample initially necessitated a 520 mV overpotential to reach a current density of 10 mA/cm^2. However, following activation with Fe, the corresponding sample showed a substantial decrease in overpotential to 350 mV, signifying a noteworthy enhancement in OER performance. Kinetic studies further confirmed the beneficial impact of Fe activation, promoting the formation of Co-Fe oxide structures, which improved charge transfer characteristics and OER kinetics. Conversely, molybdenum activation resulted in less desirable OER performance, underscoring the critical role of the chosen metal activator. This work reveals the potential of strategic elemental activation in optimizing OER performance for CoO-based catalysts, offering valuable insights for future research in sustainable energy technologies.

Abstract No. 0032 Ci-Song Chen

This study presents the fabrication and performance evaluation of high-performance flexible asymmetric supercapacitors (ASCs) using reduced graphene oxide (rGO) and lithium manganese oxide (LiMnOx) nanocomposite electrodes processed with an atmospheric-pressure plasma jet (APPJ). The rGO-LiMnOx nanocomposite was created by screen-printing a mixture of rGO and LiCl-Mn(NO3)2·4H2O pastes onto carbon cloth, followed by a rapid nitrogen atmospheric pressure plasma jet (APPJ) treatment (lasting less than 300 s). The rGO electrode was fabricated using a similar process. These electrodes were assembled with a PVA-Li2SO4 gel electrolyte to create the flexible ASC. The flexible ASC demonstrated stable operation at 1.6 V, achieving a maximum areal capacitance of 40.47 mF/cm^2 and an energy density of 9.40 μWh/cm^2. The ASC device also showed remarkable flexibility and cycling stability. The capacitance retention rate reached 89% when tested at a bending curvature of 1 cm-1, and after 4000 cycles of GCD testing, the capacitance retention rate remained at 96%. These results highlight the significant potential of this technology for future applications in flexible and wearable electronics.

Abstract No. 0033 Bo-Yan Hong

In this study, reduced graphene oxide (rGO) was used as the negative electrode, and lithium man-ganese oxide (LiMn2O4) was used as the positive electrode. Both materials were screen-printed onto carbon cloth, followed by treatment of the electrodes using furnace (400°C for 6 h) and atmospheric pressure plasma jet (APPJ) (620°C for 120 s). Finally, the two electrodes were combined with a polyvinyl alcohol-lithium sulfate (PVA-Li2SO4) gel electrolyte and dried to form a flexible asym-metric supercapacitor (ASC). In electrochemical measurements, the operating voltage was set to 1.6 V, as the maximum operating voltage for asymmetric supercapacitors using lithium sulfate electro-lyte can reach up to 2.2 V. The performance of the asymmetric supercapacitor was evaluated through cyclic voltammetry (CV), bending tests, and stability tests. The CV test results indicated that the supercapacitor subjected to both furnace and APPJ treatment exhibited the highest areal ca-pacitance at three different scan rates. The bending test results showed that the supercapacitor treat-ed with both furnace and APPJ maintained good retention rate under various curvatures. Addition-ally, the stability test results demonstrated that the supercapacitor treated with both furnace and APPJ retained 94.5% of its capacitance after 3000 charge-discharge cycles.

Abstract No. 0034 Tzu-Ho Wu

Urea electrolysis has attracted extensive attention in recent years. When decomposing urea-containing wastewater at the anode, it can produce high-purity hydrogen at the cathode simultaneously. Constructing p-n heterojunction allows the modulation of the interface electronic structure and boosts electron transfer, leading to enhanced electrocatalytic performance. We combined Ni(OH)2, triazine-based covalent organic framework (COF), and multi-walled carbon nanotubes (CNT) to from an organic-inorganic heterojunction electrocatalyst, Ni(OH)2/COF/CNT. Compared to Ni(OH)2 (86 A gNi(OH)2-1) and Ni(OH)2/CNT (211 A gNi(OH)2-1), the mass activity of the Ni(OH)2/COF/CNT heterojunction electrocatalyst is greatly enhanced to 363 A gNi(OH)2-1 at 1.5 V. Moreover, the Ni(OH)2/COF/CNT electrocatalyst exhibits considerable turnover frequency (TOF, 0.11 s-1 at 1.5 V), large reaction rate constant (k = 1.9 x 106 cm3 mol-1 s-1), high Coulombic efficiency (~98%), and meritorious catalytic stability (24 hours at 20 mA cm-2) for urea oxidation.

Abstract No. 0035 Chen-Chen Chueh

NiMoO4 was synthesized in situ on carbon paper (CP) using a hydrothermal method, followed by a rapid and high-temperature atmospheric-pressure plasma jet (APPJ) treatment to create oxygen-deficient and defective NiMoO4 on the CP surface, optimizing it as an electrode material for the oxygen evolution reaction (OER)[1]. After just 60 seconds of APPJ treatment, the electrode's overpotential at 100 mA/cm^2 decreased to 790 mV, and the charge transfer resistance dropped to 1.2 Ω, demonstrating a significant reduction in both overpotential and resistance. The performance of the NiMoO4/CP electrode treated with APPJ for 60 seconds was further evaluated in an anion exchange membrane water electrolysis (AEMWE) system. At a AEMWE system temperature of 70 °C and a current density of 100 mA/cm^2, the specific energy consumption was reduced to 42.93 kWh/kg , while the energy efficiency reached 95.1%. These findings highlight the potential of the APPJ-treated NiMoO4/CP electrode to enhance OER performance in water electrolysis, improve the energy efficiency of the AEMWE system, and offer a cost-effective and environmentally friendly alternative to precious metal electrodes.

Abstract No. 0036 Heng-Jui Liu

Over the past decades, transition metal dichalcogenides (TMDs) have demonstrated significant potential for photoelectronic and photoelectrochemical (PEC) applications due to their superior electronic structures and physicochemical properties. Among various TMDs, MoS2 and WS2 are promising candidates for PEC water splitting owing to their narrow band gaps and high carrier mobility. However, rapid carrier recombination caused by point defects continues to limit their practical applications in this field. This phenomenon is inevitable for MoS2 and WS2 synthesized through various routes. To address this issue, interface engineering and modification of TMDs have emerged as popular strategies for enhancing PEC efficiency. This talk presents a novel perpendicular-type heterostructure comprising MoS2 and WS2 fabricated using a typical RF magnetron sputtering process. Compared to pristine MoS2 or WS2 single layers, MoS2/WS2 heterostructures exhibit several-fold enhancements in PEC efficiency attributed to proper band structure alignment. Additionally, we demonstrate another promising PEC electrode constructed by oxidized WS2 on Nb-doped SrTiO3 (STO). A rarely observed cubic phase WO3-x ultrathin film shows a significant enhancement in PEC efficiency compared to the as-deposited WS2 thin film grown on Nb-STO. Our work provides new directions for designing more efficient PEC electrodes for hydrogen production through solar energy.

Abstract No. 0037 Zhi-Hui Pu

The NiCo-MOF/CP was synthesized by growing NiCo-MOF on carbon paper (CP) via the sol-vothermal method [1]. The NiCo-MOF/CP was then applied to the oxygen evolution reaction (OER). The N2 atmospheric pressure plasma jet (APPJ) was used to enhance the OER activity and durability of the electrocatalyst, thereby improving the performance of the AEMWE cell. The re-sults showed a significant improvement in activity with the ultrafast APPJ treatment. Figure 1 (a) shows the LSV test results, where the 60 s APPJ treatment achieved the best effect, reducing the overpotential at a current density of 100 mA/cm² from 843 mV to 680 mV. Figure 1 (b) shows that the charge transfer resistance decreased from 10.61 Ω to 4.14 Ω. The electrocatalyst was applied to the anode of an anion exchange membrane water electrolyzer (AEMWE), demonstrating that the 60 s APPJ treatment simultaneously enhanced both the performance and durability of the OER catalyst in the AEMWE cell. At 70 °C, the current density increased by 21.9% at 1.8 V. The degradation rate of the AEMWE decreased from 718.3 μV/h to -118.3 μV/h.

Abstract No. 0038 Karuna Gaur

A bimetallic nanomaterial or its nanocomposites are one means of increasing a biosensor's biosensing capability, which greatly enhances its specificity and sensitivity. It has been demonstrated that Au and Ag nanoparticles combined exhibit interesting and distinctive properties (e.g., biocompatibility, enhanced electro conductivity, high catalytic activity) which differ from those of the individual nanoparticles. Nanoparticles containing bimetallic elements have many advantages over their isolated counterparts, owing to their unique and synergetic properties. There are a variety of applications available for Au-Ag bimetallic nanoparticles generated physically, chemically, or biologically. We prepared Au-Ag bimetallic nanoparticles by chemical synthesis and characterized them by UV-Vis spectroscopy and HR-TEM. UV-Vis and CV cycles confirm nanoparticle formation. Glassy carbon electrodes are modified with bimetallic nanoparticles. Pb2+ was detected using a glassy carbon electrode in real water samples. Electrochemical impedance spectroscopy was used to determine the detection limit of modified GC electrodes.

Abstract No. 0039 Ming Hsien Lin

Secondary aqueous Zn ion batteries (AZIBs) show high potential for large-scale energy storage applications of renewable energy sources due to their advantages in low cost, environmental friendliness, and safety. However, adverse reactions of the zinc anode and cathode in aqueous electrolytes, such as Zn dendrite growth, unstable interfacial reaction, and severe structure deterioration, greatly hinder the development of aqueous AZIBs in practical applications[1, 2]. In this work, the dimethyl sulfoxide (DMSO)-regulated aqueous electrolytes are developed to improve the electrochemical cycling stability in Zn metal anode and VO2 cathode. The electrochemical stability of Zn plating/stripping and VO2 cathode under room-temperature and high-temperature (60°C) environments is significantly improved by DMSO-regulated electrolytes (Fig. 1). The Zn//VO2 full cells with DMSO-regulated electrolytes exhibit improved capacity retention. Moreover, the morphological change of Zn crystal evolution in plating process is directly revealed by operando/in-situ OM imaging. The effect of DMSO on mitigated structure deterioration in the VO2 cathode is characterized by ex-situ Raman and XRD studies. This work is expected to address the issues associated with the Zn metal anode and VO2 cathode to promote the development of high-performance AZIBs.

Abstract No. 0040 Yang-Ming Lu

Supercapacitors, also known as electrochemical capacitors, are regarded as one of the most promising electrochemical devices due to their high power density, fast charge and discharge rates, and excellent cycling stability. Their superior electrochemical performance can meet the growing demand for energy storage, making them a research hotspot in the field of efficient energy storage. Additionally, supercapacitors have advantages such as a wide range of material sources, long lifespan, and no secondary environmental pollution, aligning well with country current concepts of energy conservation, environmental protection, and sustainable development. This is of great significance for alleviating the energy crisis and improving environmental issues. At present, the main electrode materials used in supercapacitors include carbon materials, metals, and transition metal oxides.

This study uses different ratios of niobium oxalate as the starting material to prepare niobium oxide (Nb2O5) nanostructures via a hydrothermal method. The traditional Hummers method is modified to prepare graphene oxide (GO). Subsequently, the two components are combined using a hydrothermal method to produce niobium oxide-reduced graphene oxide composite electrode materials. The study investigates the effect of the ratio of niobium oxide to reduced graphene oxide on the supercapacitor characteristics and employs electrochemical cyclic voltammetry to measure the specific capacitance and capacitance retention.

The results indicate that under the condition of 20 wt% niobium oxalate, the synthesized composite electrode with a niobium oxide to reduced graphene oxide ratio of 1.5:1 exhibits the best electrochemical performance. At a charge-discharge current density of 1.5 A/g, the specific capacitance can reach 183 F/g, which is approximately twice the specific capacitance of an electrode made solely from pure niobium oxide. This study demonstrates that using niobium oxide and reduced graphene oxide composite materials as electrode materials for supercapacitors can effectively enhance the electrochemical characteristics of the capacitance.

Abstract No. 0041 **Chneg-Che Wu**

Lithium–sulfur batteries, with their high theoretical capacity (1,675 mA·h g–1) and energy density (2,600 W·h kg–1), are considered promising energy storage systems to be develop. However, significant challenges such as severe polysulfide diffusion during cell cycling, substantial capacity loss, and electrode degradation are inevitable. To address these issues and enhance cell performance, in this study, a low-cost cement containing calcium silicates (Figure a) is introduced in the cell design as a sulfur host and polysulfide adsorbent. The new cement/sulfur cathode can achieve a high sulfur content of 80 wt% and high sulfur loading of 6.4 mg cm−2. Furthermore, the resulting cell performance of the new cathode demonstrates high discharge capacities of 1,189–716 mA·h g–1 and high areal capacities of 7.61–4.59 mA·h cm–2 with cycling rates from C/10 to C/3 for over 200 cycles (Figure b). The high charge storage capacity further resulted in high battery energy densities of 9.63–15.89 mW·h cm–2.

Abstract No. 0042 **Shuo-En Yu**

The study demonstrated the impact of atmospheric-pressure plasma jet (APPJ) treatment on electrodeposited NiFe/CP and developed an economical processing method for oxygen evolution reaction (OER) electrocatalysts. The effects of APPJ were shown in the electrochemical properties. The sample treated with APPJ (ED-NiFe/CP-APPJ60) showed a lower Tafel slope. In the LSV test, ED-NiFe/CP-APPJ60 showed a lower overpotential at high current densities. In the EIS test, both ED-NiFe/CP and ED-NiFe/CP-APPJ60 displayed lower impedance than the CP. In the CV test, ED-NiFe/CP-APPJ60 had a larger 2Cdl value, indicating a greater electrochemical active surface area, which may be caused by the high-energy active particles in the plasma. In summary, APPJ can further enhance the electrochemical performance of ED-NiFe/CP, making it beneficial for OER and large-scale electrocatalyst applications

Abstract No. 0043 Hsing-Chen Wu

In this study, titanium fiber paper (TP) with good corrosion resistance and flexibility was prepared into an OER catalyst electrode. TP was electrochemically deposited with FeCo materials, and treated with microwave plasma (100% Ar or 100% O2). Electrochemical analysis shows that the O2 microwave plasma-treated sample exhibits a lower overpotential, meaning less energy consumption is required for the OER. The lower Tafel slope indicates a more significant increase in current density with increasing overpotential. The Ar microwave plasma-treated sample shows the highest 2Cdl value, indicating a larger electrochemical active surface area, which may be due to the defects created by the plasma and is beneficial for the OER process. Further, this sample also exhibits the lowest charge transfer resistance, indicating better performance in OER. In summary, the electrochemical deposition of FeCo and microwave plasma treatment can improve the performance of TP for the oxygen evolution reaction.

Abstract No. 0044 Pi-Chen Wei

Coordination polymers have gained attention as promising materials for electrochemical sensing due to their tunable structures and versatile functionalities. In this study, we developed an electrochemical sensor based on a crystalline material for the detection of histamine, a biogenic amine that serves as a critical indicator of food quality, particularly in fish products. We synthesized an organic-inorganic hybrid indium phosphate, $In(TIMB)_{0.5}(H_{1.5}PO_4)_2 \cdot H_2O$ (NTOU-7), under hydro(solvo)thermal conditions. NTOU-7, which features large organic ligands, high-valent indium metal, and phosphate units, was prepared as a fine powder and applied to screen-printed carbon electrodes for electrochemical sensing. The electrochemical behavior of NTOU-7 was characterized using cyclic voltammetry and square wave voltammetry. Measurements in 0.1 M phosphate-buffered saline showed distinct redox behavior for NTOU-7. Upon the addition of histamine at concentrations ranging from 1×10^{-3} to 1×10^{-15} $mol \cdot L^{-1}$, a clear oxidation potential was observed at +0.10 V (relative to Ag/AgCl). The current response of the NTOU-7 modified electrode decreased significantly with increasing histamine concentration, indicating high sensitivity and precision in histamine detection. Histamine, produced through bacterial decarboxylation of histidine under improper food storage conditions, poses significant health risks due to its stability and resistance to removal through conventional preservation techniques. Traditional methods for histamine detection, such as high-performance liquid chromatography and gas chromatography, often involve complex derivatization steps and the use of harmful organic solvents, making them less practical for real-time monitoring. In contrast, the electrochemical sensor developed in this study offers a rapid, cost-effective, and environmentally friendly alternative for histamine detection. This research highlights the significant potential of crystalline materials in electrochemical sensing applications, particularly in advancing food safety technologies. Future investigations will be directed toward improving the sensor's selectivity and evaluating its performance using real food samples. The ultimate goal is to integrate this technology into continuous monitoring systems within the food industry.

Abstract No. 0045 Keng-Hao Cheng

Lithium-ion batteries (LIBs) are widely used in portable electronics, electric vehicles and stationary energy storage systems. However, fire and explosion accidents caused by LIBs restrict their further applications. Batteries with non-flammable solid electrolytes provide enhanced battery safety and higher energy density by using lithium metal as the anode. Solid polymer electrolytes (SPEs) are flexible, scalable, and compatible with current LIB manufacturing process. Increasing the ionic conductivity of SPEs with sufficient mechanical strength is necessary to satisfy commercial requirements. In this study, the composite solid electrolytes (CSEs) with PVDF-HFP polymer matrix and SiO2 ceramic nanoparticle are prepared by solution casting. Using succinonitrile (SN) as a solid plasticizer can effectively improve the ionic conductivity of polymer electrolytes, while the mechanical strength is inevitably sacrificed. Incorporating ceramic SiO2 filler can both enhance the ionic conductivity and mechanical strength, while excess addition leads to filler agglomeration and hence decreases the ionic conductivity. The assembled Li|CSE|NCM811 solid-state coin cell with the optimized PVDF-HFP/SN/SiO2 composite solid electrolyte exhibits high specific capacity over 180mAh/g at 0.1C. High-rate cycling performance will be further investigated.

Abstract No. 0046 Gemma Maskell

Lithium manganese nickel oxide (LiNi0.5Mn1.5O4, LMNO) is a potential material for the future in mobile battery applications. This is due to the fast kinetics of the spinel structure, high operating voltage (~4.7 V vs Li+/Li) and the relatively high capacity; this all allows for a high energy and fast charging battery. Previous studies have shown that large single crystals with high phase purity are advantageous for good electrochemical performance. The current state of the art synthesis route is via molten salt with lithium chloride as the flux salt; however, this salt is not suitable for scaling beyond lab scale due to the large excess of flux salt that is required. An alternative flux salt is therefore required, and it has been discovered that lithium molybdate is a suitable alternative that requires a much lower amount of flux than lithium chloride for the successful recrystallization of polycrystalline LMNO material.

An investigation was carried out to study the effects of the holding temperature during the molten salt synthesis, the chosen range was 700 °C – 950 °C. It was observed that the largest and most crystalline single crystals were obtained at the holding temperature of 950 °C, this material also showed a good capacity and a high level of cycling stability. For lower temperatures an evolution in the recrystallization as well as an increase in Ostwald ripening is observed with increasing temperature. This also had an effect on the electrochemistry, where the smaller single crystals showed a slightly higher capacity, however the stability of the large crystals was much higher.

Additionally, the amount of lithium molybdate was also considered at 950 °C, with 5, 25 and 50 wt % chosen. It was observed that 25 wt % was the most effective, as 5 % did not recrystallize the polycrystalline material very successfully, whereas the 25 % and 50 % allowed a full recrystallization of the material, as well as very similar electrochemical behavior.

The results will be discussed from a scientific point of view and with respect to materials optimization for electrochemical application.

Abstract No. 0047 Hong-Ruei Su

Lithium metal has the highest specific capacity among metals and is the optimal choice of anode for achieving high energy density in lithium–sulfur batteries. However, lithium anodes form lithium dendrites during cycling, leading to capacity degradation. Moreover, lithium is a scarce element. The price of lithium is expensive. Reducing the use of lithium is an issue that lithium anode batteries must face. In this study, carbon nanotubes and graphene are dispersed through ultrasonic oscillation and then filtered to get a three-dimensional (3D) current collector. SiO2 is coated onto the exterior of the 3D current collector by a simple fabrication process, which produces a lithiophilic 3D current collector. The lithiophilic property of SiO2 allows melt lithium to enter the 3D current collector, aiming to reduce lithium usage while achieving better performance compared to pure lithium foil. This composite anode in lithium sulfur batteries achieves a high sulfur loading of 4 mg cm-2 and a high discharge capacity of 866 mAh g-1

Abstract No. 0048 Yi-Wei Chen

Lithium-sulfur batteries are considered as the next-generation energy storage device due to its high theoretical capacity and energy density. However, lithium-sulfur batteries suffer from irreversible active material loss and capacity degradation caused by the dissolution of liquid polysulfides in the electrolyte. The PAN (polyacrylonitrile) membrane can block the rapid diffusion of polysulfides, while the PMMA (polymethyl methacrylate) possesses highly carbonyl group that enhance elec-trolyte uptake due to its good affinity with electrolyte. Therefore, blend PAN and PMMA electro-spun membranes are applied in lithium-sulfur batteries as separator/electrolyte. In this study, we investigate the influence of electrospinning parameters on PAN/PMMA membranes. By adjusting parameters such as polymer concentration, applied voltage, and feed rate, we produce membranes with varying fiber diameter, porosity, and mechanical property. Figure 1(a) shows the microstructure of PAN/PMMA membrane with closed-packed nanofiber and smooth surface. To evaluate the electrochemical performance of the membranes, all the membranes are applied in lithium-sulfur cells with low sulfur loading and excess electrolyte. The optimized membrane enables a polysul-fide cathode to attain a high sulfur loading of 4 mg cm-2 and a long cycle life of 200 cycles, as shown in Figure 1(b), achieving initial capacity of 762 mA h g-1 and areal capacity of 3.05 mA h cm-2.

Abstract No. 0049 Rio Akbar Yuwono

Ni-rich cathode materials such as LiNi1-x-yCoxMnyO2 (NCM) and LiNi0.8Co0.15Al0.05O2 (NCA) have achieved great commercial success in these past few years. Nissan Leaf, Mercedes-Benz EQS, to Tesla electric vehicles have been using NCM and NCA as cathode material for their power unit. However, at a pack level, NCM and NCA are still far from the target energy density of 300 Wh/kg. This is mainly due to the limited depth of discharge (DOD). Increasing the DOD causes a higher capacity deterioration. Recently, increasing the oxygen pressure during solid-state synthesis of Ni-rich cathode materials has shown capacity deterioration reduction. This is mainly reported from the oxygen vacancy reduction and the electrolyte permeability limitation. However, little attention has been paid to the surface of the cathode material. It is commonly shown that Ni-rich cathodes suffer from surface instability, leading to fast capacity fade. In this work, soft XAS was performed to discern the bulk and surface structure of LiNiO2 (LNO) cathode material which was prepared under various oxygen partial pressure. Interestingly, it is found that the Ni-rich cathode material synthesized under elevated oxygen partial pressure exhibits lower surface sensitivity upon ambient air storage, which is attributed to the slower surface impurities formation. This may result from a lower catalytic activity out of Ni2+. Nevertheless, it delivers superior structural stability under harsh cycling conditions, thanks to the formation of a passivated surface containing inactive Ni4+ species. This passivated surface reduces the reactivity of the electrode-electrolyte interface.

Abstract No. 0050 Yu-Ling Wang

Vanadium Redox Flow Batteries (VRFBs) have become a leading technology for large-scale energy storage, known for their high efficiency, scalability, and extended cycle life. However, the electrochemical activity of the electrode materials plays a crucial role in determining the overall performance of VRFBs. In this research, we examine the impacts of copper (Cu) doping on the electrochemical properties of cobalt oxide (Co3O4) electrodes in VRFBs. Cu-doped Co3O4 (Cu-Co3O4) electrocatalyst was prepared through a hydrothermal method and calcination. To enhance the electrochemical performance of graphite felt (GF) electrodes for the VO2+/VO2+ couple, the prepared Cu-Co3O4 nanowires were utilized as an electrocatalyst. Electrochemical testing revealed that the Cu-Co3O4-HGF electrodes exhibited improved catalytic activity towards the vanadium redox reactions, with a significant reduction in charge transfer resistance compared to pristine Co3O4. At a higher current density of 200 mA cm−2, the VRFBs flow cell with the Cu-Co3O4-HGF electrode achieves an energy efficiency (EE) of 76.04%. This marks an improvement of 20.82%, 12.67%, and 4.93% compared to the pristine graphite felt (PGF, 55.22%), heat-treated graphite felt (HGF, 63.37%), and Co3O4-HGF (71.11%) electrode, respectively. Moreover, there is no significant decay in efficiency observed after 300 cycles of operation, indicating the excellent stability of the Cu-Co3O4-HGF electrode during continuous cycling. The superior performance of the Cu-Co3O4-HGF electrode is mainly due to the synergistic effects of Cu and Co, plentiful oxygen vacancies, and better electrical conductivity (Cu-Co3O4: 9.5x 10−5 S/m and Co3O4: 1.9 x 10−6 S/m), all of which accelerate electron transfer and increase active sites for redox reactions. This study provides valuable perspectives on the development of sophisticated electrode materials for next-generation energy storage systems.

Abstract No. 0051 Chia-Wei Chang

Photoelectrochemical (PEC) energy conversion presents a promising approach for the storage of excess energy in the form of chemical fuels. Among potential photoanode materials, Ta_3N_5 is of particular interest due to its superior charge transport properties compared to traditional transition metal oxides (TMOs), a suitable bandgap of approximately 2.1 eV for light absorption, appropriate band alignments for the oxygen evolution reaction (OER), and a theoretical solar-to-hydrogen (STH) conversion efficiency of 15.9%. Despite nearing its theoretical performance limit, Ta_3N_5-based photoanode systems face challenges related to inefficient material utilization, primarily due to the significant consumption of tantalum metal. In this study, Ta_3N_5 thin films were fabricated on n^+-Si(111) substrates via nitridation of metastable Ta_2N_3 films, synthesized through reactive magnetron sputtering. The surface composition of the Ta_3N_5 films, particularly with regard to deep-trap states such as nitrogen vacancies (V_n) and low-valence tantalum cations (Ta^{3+}), was effectively controlled by optimizing the annealing temperature. A nearly defect-free surface was obtained by annealing at 820°C for 3 hours. Furthermore, the use of Ta_2N_3 as a nitridation precursor introduced low-valence Ta_2N and Ta_5N_6 phases in the bulk material, which enhanced the carrier transport properties of the Ta_3N_5 photoanode compared to those fabricated from Ta_2O_5. In the presence of $K_4[Fe(CN)_6]$ as a hole scavenger, the Ta_3N_5/n^+-Si(111) photoanode exhibited an onset potential of 0.48 VRHE and a photocurrent density of 3.86 mA/cm^2 at 1.23 VRHE, outperforming comparable films grown on alternative substrates. These improvements in PEC performance were attributed to the formation of a heterojunction between Ta_3N_5 and Si, as confirmed by photoelectrochemical impedance spectroscopy (PEIS). The heterojunction played a critical role in charge carrier dynamics, with leakage current across the junction consuming photogenerated holes and reducing photocurrent density. This study highlights the importance of constructing a platform that enables efficient material usage in Ta_3N_5-based photoanode systems through the incorporation of silicon as a conductive substrate and the use of Ta_2N_3 as a nitridation precursor. These findings provide a foundation for further enhancing the PEC performance of silicon-based Ta_3N_5 photoanodes.

Abstract No. 0052 SI HYOUNG OH

Recent rapid growth in the global markets for electric vehicles and ESSs for renewable energy sources pushes us to develop more cost-competitive and safer alternative to LIBs. Paricularly, much attention has been paid to rechargeable batteries based on earth-abundant, safe multivalent metal resources for the last several decades, e.g., magnesium, calcium, zinc, tin, aluminum and so on. In these emerging battery systems, thin metal foil electrodes are usually utilized as an efficient, high-capacity conversion anode to meet the minimum energy density requirement for possible commercial applications. However, the use of metal electrode often accompanies some incorrigible technical issues associated with interface stability, reversibility and safety regarding the anode and its reactions. To realize a high energy density, a long cycle life and a good safety in these batteries, it is important to achieve a high efficiency (>99.5%) in metal stripping-plating reactions and induce homogeneous, dendrite-free morphology in metal deposit. In this talk, we will discuss some significant issues that need grappling with for the practical application and commercial success of multivalent batteries, and present our strategies and recent efforts to get over these challenges.

Abstract No. 0053 Yan-Xiong Liao

"Improving the energy density and cycle life specifications of lithium-ion batteries has become a common goal. In terms of cathode materials, it is expected that materials will gradually develop from high-nickel ternary materials to lithium-rich or single crystal materials. In terms of anode materials, graphite anodes will gradually develop towards silicon materials-doped or silicon-based materials. The key is that the capacity provided by the silicon-based anodes can break through the capacity limit of graphite and improve energy density of batteries. Silicon-based anodes currently have some technical obstacles, such as volume expansion, low conductivity, and low initial coulombic efficiency (ICE). Generally speaking, structural designs are adopted, including carbon-coated silicon-based particles with core-shell structure, carbon-shell pomegranate-type silicon particles like yolk-shell structure, and carbon-shell-coated micron or nanometer silicon particles with porous structure. This study uses the method of carbon coating modification to provide a layer of carbon shell for SiOx with core-shell structure. The purpose is to provide a buffer layer for the volume expansion of SiOx and control the volume effect of SiOx within the core-shell structure.

We selected CPC pitch developed by CPC Company, Taiwan as the carbon source and mixed it evenly with SiOx powder. The mixed powder was put into an atmosphere furnace and heated to proper temperature respectively in a N2 atmosphere. We obtained samples of SiOx-T1, SiOx-T2 and SiOx-T3. Electrochemical measurements were performed using a CR2032 coin cell to discuss the effect of temperature on the ICE, C-rate and 50 cycle life characteristics. SiOx-T3 has the highest ICE at 73%, while SiOx-T2 has better C-rate and cycle life capabilities than other materials."

Abstract No. 0054 Tsu-Chin Chou

The ongoing rise in atmospheric carbon dioxide (CO2) concentrations drives the search for electrochemical strategies to convert CO2 into economically valuable products. Copper-based catalysts are particularly noteworthy for their ability to produce multi-carbon and hydrocarbon compounds, with ethanol emerging as a promising alternative fuel due to its high energy density. Previous studies have highlighted key factors that influence the electrochemical reduction process, particularly the critical C-C coupling step, which is facilitated by asymmetrical CO adsorption configurations and the thermodynamic benefits of the OC-COH coupling pathway. In this work, electrochemical Fourier-transform infrared spectroscopy was employed to monitor reaction intermediates during CO2 reduction on copper, palladium, and copper-palladium bimetallic catalysts. The findings reveal distinct adsorbed intermediates on copper and palladium surfaces. CO intermediates at different sites promote the C-C coupling reaction, leading to the generation of C2+ products. These insights offer a valuable design concept for catalysts aimed at producing multi-carbon compounds through CO2 electroreduction.

Abstract No. 0055 Aknachew Mebreku Demeku

Vanadium redox flow batteries (VRFBs) present an attractive option for grid-scale electrochemical energy storage. This technology allows for the storage of multiple megawatt-hours of electricity and offer benefits like a prolonged cycling lifespan and a modular structure that can be easily scaled up. In this study, new fluorite high-entropy oxides (HEO) nanoparticles were produced using a surfactant-assisted hydrothermal technique followed by calcination and were used as novel catalytic materials for vanadium redox flow batteries (VRFB). In the HEO compounds, numerous metal cations are incorporated into single-phase crystal structures, and interactions between the different metal cations produce intriguing, unique, and unexpected features. The HEO calcined at 750°C (HEO-750) exhibits the highest electrocatalytic activities toward V3+/V2+ and VO2+/VO2+ redox couples compared with those of cells assembled with other samples. The charge-discharge tests further confirm that VRFBs using the HEO-750 catalyst demonstrate excellent coulombic efficiency (CE), voltage efficiency (VE), and energy efficiency (EE) of 97.22%, 87.47%, and 85.04% at a current density of 80 mA cm−2 and 98.10%, 74.76%, and 73.34% at a higher current density of 160 mA cm−2, respectively. Moreover, with 500 charge-discharge cycles, there is no discernible degradation. These results are attributed to the calcination heat treatment, which induces the formation of a new single-phase fluorite structure, which facilitates the redox reactions of the vanadium redox couples. Furthermore, a high surface area, wettability, and plenty of oxygen vacancies can give more surface electroactive sites, improving the electrochemical performance, the charge transfer of the redox processes, and the stability of the VRFB electrode. This research paves the way for the development of advanced HEO-based catalysts, potentially transforming the performance and economic viability of VRFBs for renewable energy applications.

Abstract No. 0056 Lee, Yi-Ying

The urea-rich wastewater could cause potential environmental issues. To address this issue, urea electrolysis can be adopted to decompose urea molecules through urea oxidation reaction (UOR). However, the anodic UOR involves multiple reaction steps accompanied by six electron transfers [1], resulting in slow reaction kinetics. Therefore, obtaining highly efficient UOR catalyst is the major challenge. Ni-based compounds are acknowledged to be the most effective catalysts in alkaline UOR [2]. Among them, Ni(OH)2 is the most commonly used catalyst. In this study, we leverage α-Ni(OH)2 as a role model to demonstrate the effects of Mo preintercalation on the UOR catalytic performance. Our results reveal that the electronic configuration of α-Ni(OH)2 can be modulated by incorporating Mo in the sample, leading to higher charge density around Ni and hence improved UOR performance. Compared to the pristine α-Ni(OH)2, the optimal MoNi-10 sample exhibits higher catalytic current (75 vs. 21 mA cm-2 at 1.4 V), lower Tafel slope (106 vs. 130 mV dec-1), and higher (0.24 vs. 0.06 s-1 at 1.50 V). Moreover, MoNi-10 has the lowest resistances, highest reaction rate constant, and good Faradaic efficiency. In addition, MoNi-10 exhibits good UOR stability without noticeable changes at 20 mA cm-2 for 24 hours.

Abstract No. 0057 **Zih-Jhong Huang**

In this study, the graphite felt electrode of the vanadium redox flow battery (VRFB) was enhanced by directly synthesizing nickel tungstate oxide (NiWO4) on the graphite felt. The oxygen vacancies present in NiWO4 serve as active sites for the redox reactions of vanadium ions, which in turn improve the battery's performance.

Both NiWO4 and NiWO4 directly synthesized on heat-treated graphite felt (HGF) demonstrated excellent electrochemical performance, as confirmed by cyclic voltammetry and electrochemical impedance analysis. In full-cell tests conducted at various current densities, NiWO4-HGF as the positive electrode achieved 85.72% voltage efficiency and 82.07% energy efficiency at 120 mA/cm², outperforming other control groups. As the current density increased to 200 mA/cm², further improvements in voltage and energy efficiencies were observed. After 500 charge-discharge cycles, there was no significant degradation in performance, indicating that NiWO4-HGF as a positive electrode exhibits long-term stability. These results demonstrate that NiWO4-HGF-modified graphite felt electrodes can not only enhance the efficiency of VRFBs but also ensure stable operation over extended periods.

Abstract No. 0059 **Ping-Chun Tsai**

A huge drop in capacity of the Ni-rich LiNixMnyCozO2 (NMC) polycrystalline (PC) cathodes stems from electrochemically induced cracking along grain boundaries. Recently, single-crystalline (SC) Ni-rich NMC particles have been reported to eliminate intergranular cracking and exhibit superior cycling capability. However, the electrochemical rate capability of PC and SC NMCs is controversial. In this work, the correlations between electrochemical kinetics and microstructures of PC and SC NMC particles were investigated. The electrochemical kinetic parameters of bulk Li+ diffusion coefficient (DLi) and interfacial exchange current density (j0) were measured from electrochemical impedance spectroscopy (EIS), potentiostatic/galvanostatic intermittent titration tests (PITT/GITT). The particle microstructures were observed with the aid of FIB+SEM, and the crack-created particle surfaces were quantified by BET. Finally, the electrochemical rate capability of PC and SC NMC was revealed.

Abstract No. 0060 **S. Kishore Babu**

In this study, a MOF-derived NiCo2O4 spinel composite integrated with single-walled carbon nanotubes (SWCNT) was synthesized via a solvothermal process for advanced energy storage applications. The composite material demonstrates significantly enhanced electrochemical performance compared to bare NiCo2O4, particularly in sodium-ion battery applications. The rate capability results indicate that, at a current density of 0.1 A/g, the NiCo2O4/SWCNT composite exhibited an initial high reversible capacity of 862 mAh/g. After 100 cycles at a current density of 0.2 A/g, the NiCo2O4/SWCNT composite achieves a high reversible sodiation capacity of approximately 603 mAh/g. At the same time, bare NiCo2O4 exhibits only 337 mAh/g. Additionally, as the current density increases, the composite material continues to deliver outstanding performance, with reversible capacities of 369 mAh/g at 2 A/g and 252 mAh/g at 5 A/g. The exceptional performance was attributed to the synergistic effect of the SWCNT, which improved electron transport and structural stability; thus, NiCo2O4/SWCNT composites can be considered substantial anode materials for the next generation of sodium-ion batteries.

Abstract No. 0061 **Pandeeswari Jayaraman**

Chloride-ion batteries (CIBs) offer significant potential as energy storage devices because of their high theoretical volumetric energy density and the abundant availability of chlorine-containing precursors. However, conventional CIBs suffer from poor cyclability due to the dissolution of chloride-containing electrode materials into liquid electrolytes.[1] In this study, a novel gel polymer electrolyte for CIBs is developed. The type and concentrations of the salts influence the ionic conductivity of the gel polymer electrolyte significantly. 0.6 M TEMACl (tetraethyl methyl ammonium chloride) exhibits the highest room temperature ionic conductivity, 4.36×10^{-4} S cm^{-1} at room temperature. The gel polymer electrolyte is further tested in a CIB configuration, utilizing BiOCl as the cathode and lithium metal as the anode. The cell exhibits a high discharge capacity of 94 mAh g^{-1} at 0.045 C at room temperature, which is 90% of its theoretical capacity. Moreover, the cell provides remarkable stability, retaining 100% capacity by the 30th cycle with 100% Coulombic efficiency, marking it the most stable CIB reported. The gel polymer electrolyte shows significant potential as an electrolyte for CIBs.

Abstract No. 0062 ChiYen Peng

Direct formic acid fuel cells (DFAFC) are considered one of the promising renewable energy sources due to their low toxicity, high open-circuit voltage, and high volumetric energy density. One of the key factors in developing high-performance DFAFCs is the use of highly active and poison-resistant anode catalysts. In previous research, our team used scanning electrochemical microscopy (SECM) to identify the optimal catalyst composition for formic acid oxidation, which was found to be Pd2Co6Au2. To further investigate the reason behind the excellent electrocatalytic activity of Pd2Co6Au2, we performed a detailed analysis of the formic acid oxidation mechanism on Pd2Co6Au2/Au/GCE using FTIR and electrochemical methods. This included studying the reaction pathway, reaction intermediates, and adsorption configurations, which were also correlated with DFT simulation results. In general, formic acid oxidation proceeds via two pathways: the direct and indirect pathways. The direct pathway involves a dehydrogenation reaction, producing carbon dioxide and protons. The indirect pathway involves dehydration, forming adsorbed carbon monoxide as a toxic intermediate, which occupies active sites and reduces the catalyst's activity. FTIR and electrochemical analyses reveal that the Pd2Co6Au2/Au/GCE catalyst operates via a bifunctional mechanism. At low potentials, the toxic intermediates formed by the indirect pathway cannot be removed. However, as the potential increases to 0.15 V, the catalyst can adsorb hydroxyl groups, allowing for the removal of the intermediates from the indirect pathway and restoring catalytic activity.

Abstract No. 0063 林秀芬

"During the charge-discharge process, functional groups from organic electrolytes may co-intercalate into the graphite layers of carbon-based materials, leading to graphite layer exfoliation and a decline in cycling performance. Furthermore, in full cells assembled with graphite anodes and LiNi0.5Mn1.5O4 (LNMO) cathodes, Mn2+ from the cathode tends to precipitate and deposit on the anode surface after multiple cycles, increasing the diffusion resistance of lithium ions and thereby affecting cycling performance. Therefore, we aim to improve the electrochemical performance of graphite anode materials in full cells through surface modification and ion doping, while also reducing Mn2+ deposition on the anode surface. In this experiment, we utilized spray drying, solid-state sintering, and chemical co-precipitation methods to modify MAGE3 graphite anode material using Li4Ti5O12 (LTO), TiO2, CuS, and F, with the goal of enhancing the electrochemical performance."

Abstract No. 0064 Chi-Yu Lai

Aqueous zinc-based energy storage devices possess superior safety, cost-effectiveness, and high energy density; however, dendritic growth and side reactions on the zinc electrode curtail their widespread applications. In this study, these issues are mitigated by introducing a polyimide (PI) nanofabric interfacial layer onto the zinc substrate. Simulations reveal that the PI nanofabric promotes a pre-desolvation process, effectively desolvating hydrated zinc ions from Zn(H2O)6 2+ to Zn(H2O)4 2+ before approaching the zinc surface. The exposed zinc ion in Zn(H2O)4 2+ provides an accelerated charge transfer process and reduces the activation energy for zinc deposition from 40 to 21 kJ mol−1. The PI nanofabric also acts as a protective barrier, reducing side reactions at the electrode. As a result, the PI-Zn symmetric cell exhibits remarkable cycling stability over 1200 h, maintaining a dendrite-free morphology and minimal byproduct formation. Moreover, the cell exhibits high stability and low voltage hysteresis even under high current densities (20 mA cm−2, 10 mAh cm−2) thanks to the 3D porous structure of PI nanofabric. When integrated into full cells, the PI-Zn||AC hybrid zinc-ion capacitor and PI-Zn||MnVOH@SWCNT zinc-ion battery achieve impressive lifespans of 15000 and 600 cycles with outstanding capacitance retention. This approach paves a novel avenue for high-performance zinc metal electrodes.

Abstract No. 0065 Yun Ku

Electrical Double Layer Capacitors (EDLCs) exhibit high power density, fast charge/discharge rates, and long cycle life, making them superior to conventional lithium-ion batteries. However, a significant challenge arises from the rapid self-discharge phenomenon, which leads to substantial voltage decay and energy loss over time, hindering practical EDLC applications. Thus, self-discharge decreases the shelf life of EDLCs and hinder their practical application. Suppression of self-discharge is crucial in the development of EDLCs, and various mechanisms have been proposed to explain this phenomenon including (i) ohmic leakage current (ii)charge redistribution (iii)ion diffusion (iv)faradaic reaction [1]. Addressing this issue is the primary focus of ongoing research. This study focuses on how the solvent influence on the self-discharge effect in EDLCs. Introducing various carbonate solvents, such as Diethyl Carbonate (DEC), Dimethyl Carbonate (DMC), Ethylene Carbonate (EC), and Ethyl Methyl Carbonate (EMC), into the 1M TEABF4/PC (Tetraethylammonium tetrafluoroborate/propylene carbonate) electrolyte can lead to distinct self-discharge mechanisms due to the varying dielectric constants of additives. (i) Low dielectric constant and large molecule size, as seen in DEC (239.4h) and EMC (165.1h), contribute to increased interfacial impedance which effectively prolonging self-discharge compared to commercial one (145.7h). Conversely, the DMC with smaller charge transfer resistance initially exhibits lower voltage decline due to reduced charge redistribution effects. However, its rapid ion diffusion process from carbon pores to electrolyte results in the fastest self-discharge of DMC (124.7h). (ii) High dielectric EC competes for solvation coordination, reducing charge transfer resistance and enhancing intermolecular interaction. This, in turn, leads to the formation of a denser electric double layer (EDL) with EC, therefore decelerating the self-discharge process (205.9h) in EDLCs. In summary, this study emphasizes the self-discharge mechanism of solvent additive in activated carbon and demonstrates a simple, safe, and cost-effective method of addressing the critical self-discharge issue in supercapacitors.

Abstract No. 0066 Hung-Yi Huang

The escalating global scarcity of water resources has precipitated the imperative to develop efficient desalination techniques. The electrochemical deionization (ECDI) method has emerged as a promising avenue to solve this pressing issue. Among various ECDI systems, conducting polymers have showcased a remarkable potential for the electrode materials due to their facile large-scale synthesis and precise control over the removal of both anions and cations [1]. In this study, we scrutinize the impact of diverse dopant sizes on the intrinsic properties of polypyrrole (PPy) chains, leading to the development of a high-performance ECDI system. By the incorporation of para-substituted groups featuring elongated carbon chains, such as dodecylbenzene sulfonate (DBS), the PPy-DBS-1//PPy-ClO4 configuration attains an excited salt-adsorption capacity (SAC) of 61.7 mg g-1 in the 10 mM NaCl solution and sustains a low energy consumption of 0.22 kWh/kg-NaCl. Our research findings accentuate the pivotal fact that the dopant size and type play key roles in enhancing the ions transport ability and the mobility of charge carriers within the conducting polymer framework [2]. Moreover, fine-tuning the doping ratio emerges as a strategic approach that enhances the cation capture ability of the electrodes and sustains their cycling stability. Overall, these insights into the symbiotic relationship between dopants and the PPy framework within the ECDI system provide a guiding framework for augmenting the electrode performance of conducting polymers with dopants and expanding the potential applications of conducting polymers in the ECDI field.

Abstract No. 0067 Yung-Tin (Frank) Pan

Cu electrodes are known to be effective in catalyzing the reduction of CO2 electrochemically into value-added multicarbon products. Studies in the literature have suggested that the localized electric field at the electrode/electrolyte interface plays a governing role in C2+ selectivity. In the present study, we will show our attempts in maximized such field enhancement by synthesizing Cu electrode catalysts via surfactant-free electrodeposition. Research finding regarding the effects of electrode cations, deposition program, and external small molecules will be systematically presented. Faceted nanocrystals were obtained when the nucleation and growth of Cu was incubated under pulse electrodeposition in the presence of CO2 and cesium sulfate (Ce2(SO4)). The obtained Cu-electrode showed compelling performance, delivering a C2+ faradaic efficiency of 84 % at 300 mA/cm2.

Abstract No. 0068 Rene Mary Amirtha

Anode-less zinc-ion hybrid supercapacitors (AL-ZHSCs) have been acknowledged as the alternative for achieving higher energy and power density as compared to conventional Zn-based electrochemical energy storage (EES) devices. However, a high nucleation barrier and non-uniform plating/stripping of Zn on copper (Cu) current collector restrict the practical application. To address those challenges, constructing the zincophilic layer to regulate the Zn2+ flux has been proven to be one of the effective strategies for stable Zn deposition [1]. Herein, 20 µm of a zincophilic layer composed of polyhedral ZIF-8 nanoparticles and sodium alginate (SA) was coated on Cu foil (denoted as Z8-SA@Cu) using a doctor-blade method. Combining the pre-zincated Z8-SA@Cu (1 mAh/cm2 of areal capacity) and commercial activated carbon (AC) cathode, the assembled AL-ZHSCs delivered not only outstanding rate capabilities (40 mAh/g at 1 mA/cm2 and 34 mAh/g at 10 mA/cm2) but also impressive life spans (capacity retention: 88 % after 12,000 cycles at 5 mA). The positive results disclosed above could be attributed to the synergetic contribution of ZIF-8 and ionic-crosslinked SA, enabling the improved Zn2+ flux and homogeneous Zn plating/stripping [2].

Abstract No. 0069 Cheng-Ying Chen

The development of renewable energy is an ongoing global trend, with thin-film solar cells playing a key role in harnessing photovoltaic effects to convert light energy into electricity. Chalcogenide-based thin-film photovoltaics, such as CdTe and Cu(In,Ga)Se2 (CIGSe), have achieved remarkable power conversion efficiencies (PCE) exceeding 22%. These materials offer wide spectral response ranges and high absorption coefficients, making them highly sensitive to low light. However, the toxicity of cadmium (Cd) and the scarcity of elements like indium (In) and tellurium (Te) present significant challenges to scaling production for global energy demands (~terawatt levels). This challenge has led to growing interest in the development of low-cost, earth-abundant thin-film solar cells. Among the most promising new generation chalcogenides are Cu2ZnSn(Se,S)4 (CZTSSe) and Cu2BaSn(S,Se)4 (CBTS). These materials contain abundant, non-toxic elements while offering optoelectronic properties similar to CIGSe, making them potential alternatives for photovoltaic applications. Their environmentally friendly composition and desirable performance characteristics make them suitable candidates for sustainable energy solutions. In addition to CZTSSe and CBTS, two other materials—Cu2O and Sb2(S,Se)3—are gaining attention for their potential in non-toxic, earth-abundant solar cell applications. Cu2O is an earth-abundant metal oxide with a direct bandgap of around 2.1 eV, ideal for visible light absorption. Sb2(S,Se)3, on the other hand, features a bandgap between 1.2 and 1.7 eV and has excellent absorption properties. It can be synthesized through cost-effective methods, making it an attractive option for next-generation thin-film photovoltaics. In this talk, I will discuss our progress in exploring these materials and their applications in solar cell technologies, focusing on the advancements that make them viable solutions for sustainable energy production.

Abstract No. 0070 **Junan Wang**

$ZnFe_2O_4$ (ZFO) has garnered attention in the field of photocatalysis due to its narrow band gap and stable physicochemical characteristics. This study explores the use of ZFO for the degradation of organic dyes such as Indigo Carmine under visible light, as well as the impact of decorating the ZFO with gold nanoparticles on their photocatalytic performance. The synthesis of pure ZFO was achieved using a hydrothermal method assisted by organic carboxylic acid, followed by the addition of varying amounts of gold nanoparticle precursors. X-ray diffraction analysis confirmed the crystal structure of the samples, with the gold-decorated ZFO exhibiting characteristic peaks consistent with pure ZFO.

The incorporation of gold nanoparticles resulted in a significant enhancement in the degradation of Indigo Carmine. While pure ZFO achieved less than 30% degradation under visible light, the Au-ZFO surpassed 90% efficiency. This improvement is attributed to the formation of heterojunctions by gold nanoparticles, which facilitated more efficient separation of charge carriers.

Abstract No. 0071 **Chi-Chang Hu**

The demand for more efficient and long-lasting batteries has spurred innovation in battery chemistry and manufacturing processes in the electronics industry. Therefore, lithium metal batteries (LMBs) have been re-proposed to enhance the specific energy density of systems by replacing the graphite negative electrode with a lithium foil due to its high theoretical capacity (3860 mAh/g) and a low redox potential (-3.04 V vs. standard hydrogen electrode). The utilization of vertically aligned graphene, grown via microwave plasma torch chemical vapor deposition, on copper (Cu) foil is investigated for its application in the "zero-excess" lithium metal batteries (ZELMBs), or the so-called anode-free lithium metal batteries. The graphene layers combining high surface area and defect concentration significantly enhance the affinity of Cu foils with the electrolyte. The vertically aligned structure of graphene layers facilitates efficient reduction of NO3 and TFSI but impedes solvent reduction. This leads to a high ratio of inorganic/organic solid electrolyte interface (SEI), enhancing ionic conductivity and reducing electrolyte consumption. The graphene layers contribute to uniform lithium-ion flux, promoting stable lithium deposition and stripping. In cycling tests for Cu//LFP ZELMBs, the graphene-modified copper (G-Cu) foil exhibits enhanced capacity retention (55%) over 100 cycles, surpassing the untreated counterpart (37.5%) in a 0.25C-charge/0.5C-discharge program. In the Li@Cu//LFP LMBs (Li@Cu: Li-pre-deposited-Cu, N/P = 1), the cell using the G-Cu substrate shows high-capacity retention of 76.7% after 300 cycles, whereas the cell with an unmodified substrate exhibits only 46.7% retention. A comprehensive analysis of the electrochemical lithium plating and stripping behavior is conducted through a three-electrode system in this work.

Abstract No. 0072 Berhanu Telay Mekonnen

"In recent times, dual-single atomic catalysts (DSACs) have emerged as attractive catalysts owing to their high ORR activities. Transition metals (Fe, Co, Ni), usually atomically stabilized by N-doped carbons, are the most commonly explored DSACs [1, 2]. In the DSACs, O2 preferentially interacts through the formation of an -O-O- bridging model [2, 3]. The bridging model on DSACs favors the cleavage of the O-O bond and thus results in a favorable 4e- transfer process [3]. Herein, well-defined DSACs of Fe-Sn, stabilized in S, N co-doped carbon (named FeSn@SNC), are synthesized using high-temperature heat treatment. The formation of the DSAC was identified by combining microscopic as well as spectroscopic techniques. The FeSn@SNC exhibited excellent ORR activities in alkaline (E1/2 = 0.86 V) electrolytes with long-term durability and enhanced methanol tolerance. The FeSn@SNC exhibited high performance as a cathode in an alkaline electrolyte membrane fuel cell (AEMFC) with high peak power densities of 277 mW cm-2. This work provides a guideline for the synthesis of nonprecious DSACs for enhanced ORR activity and suggests the design of multifunctional robust electrocatalysts for energy conversion devices.

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Abstract No. 0073 Rohan Sagar

The detection of dopamine (DA), ascorbic acid (AA), and uric acid (UA) is essential for managing various diseases. In this study, Au@MOF-60 nanocomposites were synthesized via a solvent reaction method and coated on screen-printed carbon electrodes (SPCEs), named Au@MOF-60/SPCEs, which can selectively detect DA, AA, and UA. Furthermore, nafion coating can enhance the DA signal and decrease the interference of AA and UA, which permits the nafion/Au@MOF-60/SPCEs as an electrochemical sensor for the DA detection. Under optimal conditions, the sensor exhibited a linear response range for DA between 10–500 nM, with a low detection limit of 39 nM. Moreover, the recoveries of DA in 10% serum samples reached 99%, demonstrating the method's feasibility for sensitive and reliable detection of DA. The nafion/Au@MOF-60/SPCEs show great promise for disease diagnosis and health monitoring in clinical settings. Additionally, the sensor demonstrated excellent anti-interference, stability, reproducibility, and satisfactory recovery in real sample analysis.

Abstract No. 0074 **Yu-Chung Chang**

"This study highlights an innovative approach to enhancing the hydrogen evolution reaction (HER) in alkaline media by utilizing the π-conjugated electronic effect within 3d–5d of transition metals combined 1,1'-Bi(2-Naphthol) (BINOL) hybrid nanocomposites. The design leverages both inorganic and organic components, which allows for fine-tuning of d-band states with d orbital repulsion. A key finding of this work is the determining catalytic performance with d-band hole measurement. Specifically, the synthesis of 3d-5d transition metals-BINOL in nanostructure significantly outperforms other forms and even conventional Pt/C catalysts.

The 3d–5d of transition metals combined 1,1'-Bi(2-Naphthol) (BINOL) hybrid nanocomposites exhibit superior electrocatalytic properties, with a notably low overpotential. This performance can be attributed to the enhanced interaction between the Pt nanoparticles (NPs) and the π-conjugated organic matrix, improving electron transport and active site exposure. Additionally, with a low Pt weight loading, this design not only offers high efficiency but also presents a cost-effective solution, which is critical for large-scale hydrogen production. The success of these hybrid nanostructures illustrates the importance of tuning the spatial arrangement and surface interaction of Pt NPs in HER catalysis. This work underscores the potential of combining inorganic catalysts with organic π-conjugated molecules to optimize hydrogen generation in alkaline environments."

Abstract No. 0075 **Ming-Hua Wang**

The SEI layer serves to protect the electrodes by allowing lithium ions to pass through while preventing other components of the electrolyte from further reacting with the electrode materials, thereby protecting the electrodes from further decomposition and corrosion. However, the thickness of the SEI layer plays a crucial role in determining the battery's cycle life and internal resistance. Over the course of charge-discharge cycles, the SEI layer gradually thickens, and once it reaches a certain threshold, it may impede the release of electrons from the electrodes[1]. This can also lead to the formation of lithium dendrites, which may result in the consumption of lithium ions or even the penetration of the separator, causing short circuits and accelerating battery aging[2]. The use of appropriate electrolyte additives can mitigate excessive SEI growth, allowing for more efficient lithium-ion transport and stabilization of battery performance, thus enhancing cycle life and reducing irreversible losses[3].This study focuses on understanding the impact of functional electrolyte additives on the electrochemical performance of lithium iron phosphate (LFP) batteries, while also investigating the relationship between SEI formation and battery aging. By employing various dosages of functional electrolyte additives under different formation conditions and accelerated aging scenarios, lithium-ion batteries with functional additives can effectively slow capacity decay, suppress the increase in internal resistance, and inhibit excessive SEI formation, thereby extending the cycle life of the battery by 1.5 times compared to the baseline.

Abstract No. 0076 Nattharika Runprapan

Early detection of ovarian cancer (OC) is challenging due to non-specific symptoms and a lack of effective screening methods, resulting in high mortality rates. To address these issues, there is a pressing need for a dependable, label-free immunosensor capable of accurately identifying cancer biomarkers. This research introduces a novel approach by designing a highly sensitive and specific immunosensor using gold-loaded, iron-doped nanoporous carbon (Au@Fe-NC) as the sensing platform. The Fe-NC as a primary substrate was manufactured by pyrolyzing an iron-doped metal-organic framework (MOF) of zeolitic imidazolate framework (ZIF-8) at 900°C in a nitrogen atmosphere. Fe-NC contains pyrrolic-N, which reduces Au^{3+} to Au^0 without an external reducing agent. When Fe-NC is mixed with $HAuCl_4$ solution, it forms Au@Fe-NC. This Au@Fe-NC-based immunosensor is highly stable and sensitive, making it great for detecting the OC biomarker CA-125. The sensor achieved a wide linear detection range from 0.1 pg mL^{-1} to 1 µg mL^{-1}, with a detection limit as low (LOD) as 0.1 pg mL^{-1}. The proposed immunosensor can also detect CA-125 in human serum samples, demonstrating its potential for the early detection and diagnosis of OC and its potential to improve patient outcomes.

Abstract No. 0077 YiLun Hung

The Panel Level process offers a number of advantages over wafer processing, including a higher number of processed dies, a lower manufacturing cost, a higher die yield, and less waste. However, achieving uniform plating thickness presents a challenge in the electroplating process. This study uses the finite element method (FEM) in COMSOL Multiphysics® to predict and analyze the thickness trend of copper plating. The electroplating tank structure includes anode, some regulation plate and cathode. 3D multiphysics simulations are performed comprising: (1) electrochemistry modeling with the Butler-Volmer formulations for reaction kinetics, and (2) Electrode, Shell interface to models electric current conduction in the tangential direction on a boundary. This study focuses on the effect of contact pins on the uniformity of electroplating thickness on cathode holder.

Abstract No. 0078 Yuan-Chin Chu

Lithium–sulfur batteries are a leading candidate for post-lithium-ion research, with sulfur as the cathode offering high capacity, low cost, and environmental benefits. In this study, the conventional flammable liquid electrolyte is replaced with a solid-state electrolyte to enhance safety. A large batch of Li0.34La0.56TiO3 (LLTO) is produced as a thin-film chip, providing a more competitive option for industrial-scale production. In the battery configuration, the LLTO solid-state electrolyte is used alongside a polysulfide cathode. The LLTO thin-film chip not only eliminates the flammability of liquid electrolytes but also provides a fast channel for lithium-ion transport and prevents polysulfide loss. Meanwhile, the polysulfide cathode, replacing the traditional solid-state sulfur cathode, improves reaction kinetics and active material utilization. From the SEM microstructure, a dense solid-state electrolyte structure (Figure 1) with a thickness of 60 μm (Figure 2) can be observed, which significantly enhances the energy density of the battery. Additionally, electrochemical analysis confirmed the electrodes exhibit stable lithium stripping and plating characteristics. In terms of battery performance, it demonstrated a capacity of 1053 mAh g-1, high-rate capability, and electrochemical efficiency (Figure 3).

Abstract No. 0079 Chun-Wei Chiang

Cu-Cu interconnection has attracted increasing attention as the bump pitch becomes smaller and smaller. To achieve fine pitch interconnection, Cu-Cu direct bonding or hybrid bonding without solder in the bonding layer are the promising technologies. There are some difficulties in solderless bonding, such as bump uniformity control, high precision CMP process and so on. In particular, the accurate control of the surface shape is the essential issue. To solve these problems, we propose Cu particle materials as interconnect materials. In this paper, Cu particles for direct bonding were prepared by selectively dissolving Zn atoms from the Cu-Zn alloy, and the influences of the electroplating conditions of the Cu-Zn alloy and the dealloying conditions on the properties of the structures were investigated.

Abstract No. 0080 Chusnul Khotimah

Spinel LiNi0.5Mn1.5O4 (LNMO) is one of the attractive cathodes due to several advantages such as Co-free for low cost and high operating voltage (~5V). Normally, there are Fd3¯m and P¬4_3 32space group types of LNMOs. However, both LNMOs suffer phase segregation at intragranular side which affects the lithium diffusion pathway and structural degradation during cycles. On the other hand, Jahn-Teller distortion on Mn3+ as well as HF effects from electrolyte oxidation at high voltage window triggered lead Mn dissolution from LNMO that causes performance fade. In this work, a new salt is developed, lithium 1-fluoro benzimidazole (Li-1FB) for LNMO with two different space groups. Ex-situ XRD results show the Li-1FB postpones the formation of intermediate phase transition on both LNMOs at different states of charge. In addition, 1H NMR analysis reveals the Li-1FB salt can prevent HF formation by the N-Li functional group of imidazole ring thus inhibits Mn dissolution on both LNMOs after cycling. Furthermore, the Li-1FB salt is suitable to improve cycle performance of both LNMOs in half-cell (Li metal as anode) and full cell (graphite as anode) applications. This new salt provides dramatic improvements, and it is suitable for further high-energy applications.

Abstract No. 0081 Tai-Feng Hung

Anode-free or anode-less configurations have recently gained much attention in developing electrochemical energy storage (EES) devices owing to the significant enhancement in terms of weight and volume energy densities compared to conventional EES ones [1]. Utilizing Cu foil as a current collector, however, such a design typically suffers from an obvious nucleation overpotential and non-uniform plating/stripping, leading to poor Coulombic efficiency and limited cyclability. In this study, a zincophilic layer consisting of polyhedral ZIF-8 and sodium alginate was coated on the Zn foil (Z8-SA@Zn). Benefiting from the synergetic contribution of ZIF-8 and ionic-crosslinked SA, it demonstrated the remarkably anti-corrosive property, insignificant zincate growth, high Coulombic efficiency, and prolonged cyclability [2]. Inspired by the positive results disclosed above, Z8-SA@Cu was further prepared to explore the electrochemical performances of anode-less zinc-ion hybrid supercapacitors (AL-ZHSCs). Encouragingly, the assembled AL-ZHSCs adopting the pre-zincated Z8-SA@Cu (1 mAh/cm2 of areal capacity) as the anode delivered not only outstanding rate capabilities (40 mAh/g at 1 mA/cm2 and 34 mAh/g at 10 mA/cm2) but also impressive life spans (capacity retention: 88 % after 12,000 cycles at 5 mA). Moreover, the energy and power densities outputted from AL-ZHSCs at 10 mA/cm2 were about 6.4 and 7.0 times higher than the one using Z8-SA@Zn as the anode, respectively, suggesting Z8-SA@Cu to be a promising candidate for AL-ZHSCs.

Abstract No. 0082 Minoru Inaba

In this talk, we report our recent progress on the performance of partially oxidized Si nanoflake anode in highly concentrated electrolytes (HCE) based on LiFSI/glyme (G2, G3, and G4) systems that are much more stable against reduction and thus effective to reduce the swelling of the electrode during cycling. Good cycleability was obtained for the SiO-LP anode up to 1000 cycles without any film-forming additives. In addition, the swelling of the electrode was remarkably reduced after cycling. The performance in localized HCE (LHCE) using fluorinated diluents are also discussed.

Abstract No. 0083 Laurien Merinda

Ni-rich layered cathodes have a high practical capacity (>200 mAh·g−1) and tapped density (>3.6 mg·cm-2), thus attracting wide attention in large applications such as electric vehicles and energy storage. However, high surface reactivity of these cathodes promotes the decomposition of carbonates solvents, which contributes to the growth of the cathode–electrolyte interphase (CEI) as well as rapid fading of the battery's capacity during long-term cycle. Carbonates are favorable for deprotonation reaction by the oxygen atom in the Ni-rich layered cathode and further in the formation of the CEI. In this study, the deprotonation mechanism of cyclic and linear carbonates on a Ni-rich layered cathode was thoroughly investigated using operando Fourier-transfer infrared spectroscopy, and the reasons for cathode fading could be confirmed in terms of the carbonate structures. In addition, a new maleimide oligomer was developed and covered on a Ni-rich layered cathode to inhibit the deprotonation of the carbonates. The maleimide oligomer acts as a cis isomerism that provides a bridge function for reacting with oxygen on the cathode surface by its cis formulation. Moreover, this bridge function will keep the carbonates away from the cathode surface for further decomposition during cycling. On the contrary, the battery performance exhibited a cycling ability at a high rate, and the new cis isomerism maleimide oligomer helped improve the rate capability.

Abstract No. 0084 **You-Kai Wu**

In this study, the $ZnWO_4$ membrane was deposited using RF magnetron sputtering and integrated with a commercial MOSFET gate electrode to fabricate extended gate field-effect transistor (EGFET) pH sensor. The fabricated sensor was immersed in buffer solutions with pH values ranging from 4 to 12, demonstrating a current sensitivity of 45.30 μA/pH in the saturation region with a linearity of 98.31%, and a voltage sensitivity of 31.91 mV/pH in the linear region with a linearity of 96.81%. These results indicate that $ZnWO_4$-based EGFET pH sensor is a robust device with a promising sensing membrane and have great potential for pH sensing applications.

Abstract No. 0085 **Wei-Nien Su**

The global demand for ultrapure energy, particularly hydrogen, is rapidly increasing. In the quest for sustainability and efficiency, electrochemical approaches offer versatile and economically viable solutions. Rather than solely relying on water electrolysis for hydrogen production, integrating alternative anodic oxidation reactions with hydrogen evolution reactions presents a promising strategy. This method enables the transformation of low-grade molecules, such as biomass-derived compounds and industrial waste solutions, into valuable products, potentially replacing the slow oxygen evolution reaction in sustainable electrochemical energy systems. This presentation provides an overview of electrooxidation reactions that facilitate the production of green hydrogen with minimal electricity consumption, alongside the generation of valuable chemicals from inexpensive small-molecule oxidants. Additionally, it addresses current challenges and future perspectives in the development of electrocatalysts.

Abstract No. 0086 Jia-Hua Wu

In this study, the sensing layer of an Extended Gate Field-Effect Transistor (EGFET) pH sensor was fabricated via sputtering on a glass substrate. A 30nm nickel (Ni) layer and a 70nm gold (Au) layer were deposited using the thermal evaporation system. Due to the lack of a custom mask, a glass slide was used to shield non-coated areas, resulting in less precise coating. pH measurements were conducted using solutions with pH values ranging from 4 to 12, and data acquisition was performed with the B2902A. The sensor exhibited a current sensitivity of 31.83 μA/pH and a voltage sensitivity of 20.58 mV/pH, with a linearity of 96.74%. These results indicate that this EGFET pH sensor holds great potential for future pH sensing applications. In the future, AIGO pH sensors can be combined in different fields, such as biomedical science, agriculture, and fishery, for sensing applications and pH real-time monitoring.

Abstract No. 0087 Yan-You Liu

Bimetallic sulfide is one of promising battery-type materials owing to multiple redox states of two metals and high conductivity of sulfur. Thioacetamide is a commonly applied sulfur source. Morphology of active material can also be modulated by thioacetamide. However, the function of thioacetamide in different metal precursor solutions is not clear. In this work, two bimetallic compounds, cobalt copper compound and iron copper compound, are synthesized using thioacetamide as the possible sulfur source and structure directing agent (SDA). The cobalt copper sulfide (Co-Cu-S) is successfully synthesized with tube-like structures. The optimal Co-Cu-S electrode presents a specific capacitance (CF) of 696.9 F/g at 20 mV/s (Figure 1). However, with the same synthetic process, the iron copper oxide is formed. Thioacetamide is thus considered as SDA but not the sulfur source in the system with iron ions. A CF value of 345.7 F/g at 20 mV/s is achieved for the optimal iron copper oxide. The battery supercapacitor hybrid with a Co-Cu-S positive electrode shows a maximum energy density of 15.1 Wh/kg at 857.1 W/kg. The CF retention of 80.1% and Coulombic efficiency of 91.0% are achieved after 6000 cycles (Figure 2) .

Abstract No. 0088 Tzu-Ching Chan

Lithium–sulfur batteries, which feature high theoretical specific capacity, are one of the promising candidates for developing high energy density rechargeable batteries. However, the insulating active materials, the slow electrochemical conversion reactions, and the continuously irreversible diffusion of polysulfides hinder the commercialization progress of lithium–sulfur batteries. To address the above problem, in this study, we introduced the design of a sandwich-structural triple-layered electrospun polymeric membrane with polyacrylonitrile (PAN) to block the fast diffusion of polysulfides and poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP) to facilitate stable lithium-ion transfer, thereby improving the electrochemical performance of the lithium–sulfur cell with a high-loading sulfur cathode of 4 mg cm−2. The cells assembled in this study achieved a high areal capacity of 5.75 mAh cm−2, a high energy density of 12.08 mWh cm−2, and a satisfactory rate performance of C/10–C/2, indicating that the optimized structural design of the separator/electrolyte could improve the electrochemistry and cell performance of lithium–sulfur cells.

Abstract No. 0089 Shih-Lun Yang

The demand for energy storage systems is growing annually, and safety concerns are becoming increasingly important. All-solid-state lithium-sulfur batteries (ASSLSBs) offer an ideal energy storage solution by combining the high specific capacity of sulfur with excellent safety performance. However, low conductivity of sulfur is a major obstacle. Furthermore, the expansion and contraction during cycling can also lead to the loss of solid-solid interfacial contact between the active material and the conductive material, which damages the cyclability. In this study, we plated conductive metal on insulating sulfur powder through electroless plating technique to synthesis metal/sulfur composite cathodes and applied it to ASSLSB. Metal plated on sulfur can enhance conductivity of sulfur powder, and previous studies have also confirmed the catalytic performance of metal for sulfur reactions, thereby improving activity and benefiting the overall reaction. Direct plating tin on the sulfur ensures good contact between sulfur and conductive materials, which not only enhances conductivity but also prevents the contact lost during cycling. In this research, our ASSLB achieved high specific discharge capacity of more than 800 mA h g-1 and high Coulombic efficiency of over 95% at room temperature, which prove the excellent reversibility and safety of our ASSLBs. As shown in Figure 1, the charge-discharge curves are nearly identical, and the cell retains high capacity even after multiple cycles. This indicates that the metal/sulfur composite enhances cyclability and provides a stable reaction. The all-solid-state design also fundamentally prevents the dissolution of polysulfides, offering significant advantages in improving cycle performance.

Abstract No. 0090 Shih-Huang PAN

Ammonia (NH3) is crucial in renewable energy and agriculture, yet its traditional production via the Haber-Bosch process faces challenges due to the inherent inertness of nitrogen (N2) and the need for high temperatures and pressures. The electrocatalytic nitrogen reduction (ENRR) presents a more sustainable option, functioning at ambient conditions. However, its advancement is limited by selectivity and efficiency challenges due to the competing hydrogen evolution reaction (HER). The critical roles of protonation of N-species and HER highlight the necessity of selecting optimal catalysts and solvents to enhance ENRR performance. Notably, transition metal oxides, with their adjustable electronic states and excellent chemical and thermal stability, have shown promising ENRR characteristics. In this study, we use density functional theory (DFT) methods to investigate the ENRR mechanisms on IrO2 (110), a material known for its tunable electronic properties and exceptional chemical and thermal stability. Employing the constant electrode potential (CEP) model, where the electrode - electrolyte interface is treated as a polarizable continuum with implicit solvation, and adjusting electron counts to equalize work functions in the grand canonical ensemble, we further incorporate the advanced 3D Reference Interaction Site Model (3D-RISM) to accurately determine the ENRR limiting potential across various solvents and pH conditions. Our findings reveal that the limiting potential for ENRR on IrO2 (110) is significantly more favorable than for HER, highlighting the efficiency of the IrO2 catalyst for converting N2 to NH3. This is supported by the optimal *NH3 desorption energy on IrO2, which enhances the overall reaction efficiency. Microkinetic simulations further predict a promising NH3 production rate, even at the solution's boiling point, reinforcing the catalytic viability of IrO2 (110). This comprehensive approach provides an atomic-level understanding of the electrode-electrolyte interface in ENRR, demonstrating the practical application of IrO2 in electrochemical catalysis. The findings provide a foundation for developing more efficient and selective catalytic strategies, potentially revolutionizing industrial NH3 production.

Abstract No. 0091 Chuang Kai Jie

"Designing BiVO4 with a large surface area and more oxygen vacancies can improve its electron diffusion and photocatalytic ability for water oxidation. An alkaline etching process is known to enhance BiVO4's light absorption and oxygen vacancies, but detailed studies on its effects are limited. In this study, BiVO4 was etched with alkaline for different durations using a hydrothermal method to enhance its water oxidation ability. Longer etching times resulted in rougher surfaces, more oxygen vacancies, and better light absorption. These changes led to higher carrier densities and lower chargetransfer resistance. The best photocurrent density of 2.38 mA/cm^2 was achieved at 1.23 V with 45-minute etching, compared to only 0.59 mA/cm^2 for unetched BiVO4. The etched BiVO4 also retained 81% of its photocurrent after 6000 seconds of continuous illumination. These findings suggest alkaline etching can significantly improve the photocatalytic performance of BiVO4."

Abstract No. 0092 Panitat Hasin

In the class of transition metal compounds, the oxides, sulfides, and phosphides of cobalt, molybdenum, and ruthenium are the favorable candidates as the next generation electrode materials for supercapacitors (SCs) because of their superior specific capacity, cost-effectiveness, and abundance as the resources. Unfortunately, the oxides, sulfides, and phosphides of cobalt, molybdenum, and ruthenium have low conductivity, diffusion-limited capacity, and short cycle life in SC application. Therefore, utilizing transition metal compounds with carbons as the composite electrode materials for energy storage systems can solve the above issues. Carbon nanomaterials with distinct morphologies such as mesoporous carbons, hierarchical porous carbons, graphene, and carbon nanotubes have attracted great interest, mainly owing to their high electrical conductivity, outstanding mechanical flexibility, chemical stability, and huge surface area. In addition, the insertion of heteroatoms, i.e., P, S, and N into carbon-containing materials has drawn huge attention for improving storage capacity. The hybrid combination of the oxides, sulfides, and phosphides of cobalt, molybdenum, and ruthenium and carbon nanomaterials such as mesoporous carbons, hierarchical porous carbons, and graphene can enhance the electrochemical redox properties, electrical conductivity, reversibility, and cycle stability of the electrodes via a synergistic effect. The prepared nanocomposite shows an enhanced active surface area, and the carbon nanomaterials assist in the continual transport of electrons. The study results reveal that the composites have improved specific capacitance performance with better cyclic stability compared to single transition metal compound and carbon nanomaterial. Thus, the current research work suggests the easy and productive approaches for making supreme-performance transition metals-decorated heteroatomic-doped carbon electrode materials for next-generation high-performance energy storage devices, presenting significant market capability.

Abstract No. 0093 Liang-Jun Guo

Aqueous rechargeable zinc-ion batteries (ARZIBs) hold great potential for future battery development due to their high safety, low cost, and environmental friendliness. Zinc is favored as an anode material because of its low redox potential (-0.76 V vs S.H.E) and high theoretical capacity (820 mAh g^{-1}) [1]. While vanadium oxide cathodes with good electrochemical performance have been reported, they are typically produced through high-temperature methods such as hydrothermal processes or calcination [2-3]. Herein, we reveal a simple, efficient, and low-energy synthetic route to effectively convert relatively inactive α-V2O5 (131 mAh g−1 at 0.1 A g−1) into highly active MxV8O20·nH2O (MVO, M = Li, Na, and K) by liquid-phase dissolution-recrystallization reaction and chemical preintercalation under low-temperature conditions. Particularly, NaVO presents the most expansive diffusion channel, the highest specific surface area, and the smallest band gap, allowing faster electron/ion transport kinetics and better material utilization. With these features, NaVO shows high capacity (383 mAh g−1 at 0.1 A g−1) and rate-performance (207 mAh g−1 at 8 A g−1). More importantly, high-areal-capacity of 3.2 mAh cm−2 and remarkable cycle stability over 1500 cycles can be achieved from free-standing high-mass-loading electrode (~14 mg cm−2) made of NaVO and multi-walled carbon nanotubes (MWCNTs). This work enriches the synthetic methods for obtaining high-performance vanadium-based host materials with practical areal capacity and cycle stability.

Abstract No. 0094 Shen-Wei Yu

The creation of metal-metal oxide interfaces is an important approach to fine-tuning catalyst properties through strong interfacial interactions. This research presents the work on developing interfaces between Pt and CeOx that improve Pt surface energetics for the hydrogen evolution reaction (HER) within an alkaline electrolyte. The Pt-CeOx interfaces are formed by depositing size-controlled Pt nanoparticles onto a carbon support already coated with ultrathin CeOx nanosheets. This interface structure facilitates substantial electron transfer from Pt to CeOx, resulting in decreased hydrogen binding energies on Pt surfaces, and water dissociation for the HER, as predicted by the density functional theory (DFT) calculations. Electrochemical testing indicates that both Pt specific activity and mass activity are improved by a factor of 2 to 3 following the formation of Pt-CeOx interfaces. This study underscores the significance and potential of harnessing robust interfacial effects to enhance electrocatalytic reactions.

Abstract No. 0095 Yen-Fu Chen

In this study, we adapt thermal annealing in order to improve the sensitivity of IHGO (InHfGaO) pH sensor. The InHfGaO pH sensor via thermal annealing 700 °C set as treatment group. In ID-VD and ID-VG figure we obtain worse linear property after annealing 700°C and measure reflectance and transmittance then get the energy gap of non-annealing is 3.54 eV and 700°C annealing energy gap is 2.25 eV. From AFM analysis can be found IHGO with annealing surface is more rough and uneven but IHGO without annealing is more smoothly and flat. Finally, we get the best current and voltage sensitivity 58.75 μA/pH and 33.44 mV/pH.

Abstract No. 0096 Hsu, Feng Hao

We proposed the energy storage mechanism of various crystal structures of MoO3 (α-MoO3, β-MoO3 and h-MoO3) electrode materials in aqueous aluminum-ion solution. We observe that the electrochemical performance of each electrode material significantly associate with various MoO3 crystal structure. According to in-situ X-ray diffraction (XRD) and X-ray absorption spectroscope (XAS) results, we observe that the crystal structure of α-MoO3 and β-MoO3 reveals significant distortion, whereas that of h-MoO3 is minorly affected during the insertion or extraction of Al3+ ions. Importantly, in-situ XRD and XAS also clearly show a possible phase of AlxMoO3 during the Al3+ insertion and extraction cycles, which may play a crucial role for the behavior of the residue of Al3+ ion and poor cycle stability for α-MoO3 and β-MoO3 electrode materials. We provide some evidences to support the Al-ion energy storage performance is strongly associated with the corresponding ion storage space and the stability of their crystal structures. This work can also provide a new insight into a strong correlation between ion-storage efficiency and the corresponding crystal structure, which is greatly helpful for the development and improvement of new electrode materials for aluminum-ion energy storage.

Abstract No. 0097 Meng-Chang Lin

Dual graphite batteries (DGBs) utilize graphite as an intercalation host, storing energy through the redox reactions of ions derived from ionic liquid (IL) electrolytes interacting with graphite electrodes. The intercalation of bulky imidazolium-based cations into the negative graphite electrode leads to its degradation, thereby exacerbating self-discharge phenomena. The intercalation of 1,2-dimethyl-3-propylimidazolium (DMPI+) cations within the negative graphite electrode has been investigated using operando X-ray diffraction and Raman spectroscopy. The findings indicate that these cations are primarily accommodated within the superficial layer of bulk graphite, exhibiting minimal penetration into the deeper graphite lattice, which contrasts sharply with the intercalation of AlCl4− counter-anions in the positive graphite electrode. Further examination suggests that the kinetics of DMPI+ storage are predominantly characterized by intercalation pseudocapacitance, while first-principles calculations indicate that intercalation is thermodynamically more advantageous than surface adsorption. The recycling and reuse of valuable IL electrolytes and metallic Ni current collectors may enhance the practical application of DGBs. Preliminary findings regarding the recycling of a spent DGB utilizing a (DMPI+)(AlCl4−) electrolyte are presented, revealing recovery rates for most components (including graphite flakes and Ni current collectors) ranging from 84% to 98%, whereas the recovery rate for the IL electrolyte is only 24%. Encouragingly, the cost of a DGB constructed from recycled components could be reduced by approximately 68%. These investigations contribute to a deeper understanding of the factors affecting the performance of DGBs with IL electrolytes and facilitate the advancement of energy storage systems with enhanced power and energy densities. Moreover, the development of recycling processes may enhance the competitiveness of DGBs for large-scale energy storage applications.

Abstract No. 0098 **Manoj Kumar Mohanta**

Photoelectrochemical (PEC) water splitting is a suitable and promising approach to generate hydrogen (H2), a carbon-zero clean energy source, and oxygen (O2). Herein, we fabricated hetero-structured CBO/CuO photocathodes on the fluorine-doped tin oxide (FTO) substrate by a 2-step electrodeposition method. The very thin CuO layer, covering the flake structures of CBO, forms type-II band alignment and facilitates the separation of photogenerated electrons and holes. A superior photocurrent density of -4.75 mA/cm2 for CBO/CuO photocathode in aqueous solutions with the addition of electron scavenger confirms the PEC performance enhancement along with the minimization of charge recombination. We also sought to perform the reduction of furfural photoelectrochemically with CBO/CuO photocathodes in mixed acetonitrile/water medium. This work offers a cost-effective strategy to synthesize highly efficient photocathodes and expand the application prospects of photoelectrocatalysis toward upgrading biomass-derived feedstocks.

Abstract No. 0099 **Guo-Kai Xu**

In recent years, with technological advancements, lithium-ion batteries have become ubiquitous in daily life. One of the main focuses for scientists is the development of high-energy-density lithium-ion batteries (LIBs). The primary limitation of these batteries' capacity is often attributed to the cathode materials. Therefore, the aim of this research is to explore how surface modification techniques can enhance the discharge capacity of lithium-ion batteries. In this study, single-walled carbon nanotubes (SWCNT) were used to modify 5V lithium nickel manganese oxide ($LiNi_{0.5}Mn_{1.5}O_4$, referred to as LNMO) cathode materials. By forming an electronic conducting network on the LNMO surface, electrons can travel more quickly between LNMO particles. Electrochemical performance studies confirmed that, as compared to unmodified LNMO, the electronic conductivity increased from 3.1×10^{-3} Scm-1 to 3.2×10^{-2} Scm-1. Additionally, at a 0.1C/0.1C rate, the specific capacity increased from 123.7 mAh g^{-1} to 133.1 mAh g^{-1}. Furthermore, at 1C/1C charge/discharge tests, it was found that the capacity retention of the unmodified LNMO dropped to just 43.23% after 500 cycles, whereas our modified LNMO maintained an exceptionally high retention rate of 96.27%. Based on these experimental results, it can be concluded that modified LNMO@SWCNT composite exhibits excellent electrochemical performance, making this composite cathode material highly promising for future high-energy density lithium-ion battery applications.

Abstract No. 0100 Chao-Hsiang Hsu

State-of-the-art solid-state electrolytes (SSEs) with superior ionic conductivity have been developed for all-solid-state lithium batteries (ASSLBs), Because of its high safety and high theoretical energy density, it is considered a promising energy storage device. However, most solid electrolytes show low chemical and electrochemical compatibility with commercial cathodes, which may be a factor in the rapid degradation of battery performance. While it is hard to quantify the reaction energies and clarify the main interfacial degradation factors of interfacial reactions through experimental characterization techniques. In this work, ab-initio calculations were utilized to determine the interfacial chemical and electrochemical stability of various solid-state electrolyte and cathode interfaces as a function of the state-of-charge (SoC). The results show that most interfaces are not thermodynamically stable, and become more unstable with increasing SoC. By inserting a highly stable interlayer between the electrolyte and cathode, the electrolyte/interlayer/cathode interface achieves high stability. Further, ab-initio calculations were utilized to evaluate and comparable phase stability, chemical stability, electrochemical stability, and conductivity of electrons and ions of 40 experimentally reported coating materials to stabilize SSEs and cathodes interface.

Abstract No. 0101 Bo-Rong Zhang

"In this study, a novel $LiTa_2PO_8$ (LTPO) Li+-ion conducting material with high lithium-ion conductivity and chemical stability was prepared by using the solid-state reaction method. The material was sintered at 1050°C in an air atmosphere for 10 h, with varying compositions (i.e., 5, 10, 15 mol.%) of lithium hydroxide (LiOH) as a lithium source to compensate for lithium loss during high-temperature sintering. XRD analysis confirmed the LTPO material prepared with an excess of 10 mol.% LiOH had the optimal condition based on crystal phase structure result. DLS also confirmed the particle size was around 1 μm. Composite polymer electrolytes (CPEs) with bilayer structure were prepared by using LTPO fillers, PVDF-HFP, LiTFSI, and SN. The lithium-ion conductivity and ion transference number of CPEs was examined. The as-prepared CPEs was applied in all-solid-state lithium metal batteries (ASSLMB) for electrochemical analysis. The experimental results showed that the CPEs with 50 wt.% LTPO fillers had a lithium-ion conductivity of 4.6×10^{-4} S cm^{-1} at room temperature and a low activation energy (Ea) of 0.35 eV. At 0.1C/0.1C rate for 3 cycles of charge/discharge for activation, the ASSLMB based on 50 wt.% LTPO CPEs had a discharge specific capacity of 190.98 mAh g^{-1} in the third cycle. For the long-term cycling test at 0.1C/0.1C for 30 cycles, the capacity retention was as high as 97.88%. At 0.2C/0.5C rate for 100 cycles, the average discharge specific capacity was approximately 167.75 mAh g^{-1}, with a capacity retention of 91.40% and an average coulombic efficiency of 99.02%. Compared to the ASSLMB comprised of the 10 and 50 wt.% LTPO in CPEs, it was discovered that our ASSLMB based on CPEs with 50 wt.% LTPO fillers showed higher long-term stability and coulombic efficiency."

Abstract No. 0102 Hohg-Zhi Lin

In recent years, the rapid demand of the electric vehicle and energy storage markets, Li ion battery has been concerns, which was related to the thermal runaway and explosion safety issues. To address this issue, all-solid-state lithium-ion batteries have been developed as a solution to the problems of existing liquid lithium-ion batteries. Therefore, the aim of this study is to explore how to improve the capacity retention of all-solid-state lithium-ion batteries (ASSLMBs) based on NCM811 during long-term cycling. In this work, Li-Nafion was used to modify the single crystal $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ (denoted as SC-NCM811) cathode material. By forming a lithium-containing protective layer on the surface of SCNCM811, this Li^+-conducting layer can markedly reduce side reactions during charge and discharge. In addition, LATP and SWCNT were added to the cathode to enhance ion and electron conduction, forming an efficient 3D conductive network. Electrochemical performance studies revealed that, the discharge capacity was increased from 51.07 mAh g^{-1} to 161.20 mAh g^{-1} at 2C rate, as compared to unmodified NCM811. Furthermore, at 0.2C/0.5C rate, the capacity retention of the unmodified NCM811 electrode was dropped to 76.99% after 100 cycles. While, our as-modified SC-NCM811 electrode maintained excellent capacity retention of 97.50%. Based on those experimental results, it can be concluded that this as-modified SC-NCM811cathode exhibits highly promising for applications in all-solid-state lithium-ion batteries.

Abstract No. 0103 Sofiannisa Aulia

The renewable power-to-X (P2X) provides the flexibility of household scale production of chemicals and 2e-ORR/ Zn air battery being one the example which produces H_2O_2 on-site simultaneous electricity.[1-2] The noble metal catalysts are known to perform excellently for H_2O_2 electro-generation, but they suffer from the dissolution issue of the catalyst. Among the catalysts in trend for the H_2O_2 electro-production, PBA could serve as the active material with good stability and dispersed active metal within the framework. Recently, Zn has shown superior activity in the H_2O_2 electrochemical production in various types such as alloy, oxide, and MOF like PBA.[3-4] Combined with the open framework of PBA, the H_2O_2 electrocatalyst could have the dispersed active sites and performs stably. Herein, we propose the ZnFe PBA decorated with NGQDs, which improves the selectivity and productivity of H_2O_2. The FTIR spectra in Fig. (a) depict the C-N and C=O functional group which belongs specifically to the NGQD, showing the successful incorporation of the quantum dots within the PBA. Zn L-edge spectra depict the Zn peak's shift into the lower photon energy (Fig. (b)). This phenomenon could happen due to the interference of the NGQDs, which act as the electron donor to the Zn within the ZnFe framework.[5] The change contributes to the performance of ZnFe PBA/ NGQDs with the selectivity of 94.3% and n value of 2.2 at 0.6 V (Fig. c). The implementation of ZnFe PBA/ NGQDs in zinc flow battery could exhibit the specific capacity and H_2O_2 production rate much higher than ZnFe PBA (Fig. d).

Abstract No. 0104 Yu-Ru Liu

To address energy and environmental challenges, it is essential to develop cost-effective, efficient, and non-precious metal electrocatalysts as alternatives to platinum catalysts used in the hydrogen evolution reaction (HER). This work aims to achieve a cost-effective electrocatalyst for HER using Prussian blue analogues (PBAs) as precursors[1]. Meanwhile, this work seeks to introduce the concept of high-entropy alloys to design high-entropy PBAs (HEPBAs) derived metal phosphite as well[2, 3]. By incorporating multiple non-precious metals, it can control their excessive metal electron configuration and material structure, thereby potentially enhancing electrocatalytic activity. Among various base metal catalysts, transition metal phosphides exhibit significant advantages for overall water splitting, owing to their corrosion resistance, and notable activity. Not only that, unoccupied d orbitals and unpaired d electrons make them an alternative to noble metal catalysts. Therefore, it is anticipated that high-entropy CoFeNiCuMn-PBA/CNT can enhance the HER performance after phosphorization. HEPBA derived HE-metal phosphite exhibits excellent HER performance with achieving an overpotential of 441 mV to reach a current density of 1000 mA cm-2 in 1.0 M KOH. This study offers a strategy for investigating transition-metal-phosphides as high-performance electrode materials for water splitting and other energy conversion applications.

Abstract No. 0105 Tzu-Ting Liu

The growing need for value-added chemicals presents an opportunity for the development of power-to-X (P2X) technologies which offers practicality, safety, and cost-effectiveness. As one of the important chemicals in daily life, hydrogen peroxide could be generated in this power-to-X system using an inexpensive zinc-air battery (ZAB) platform. In this P2X system, the ZAB operation shifts from the typical 4e- oxygen reduction reaction (ORR) into the 2e- ORR that yields H2O2 while simultaneously produces electricity.[1] Herein, we propose CNTs decorated with fluorinated graphene quantum dots (FGQDs), which has the combined benefits of more exposure of the active edge sites and F-doping owned by the GQDs embedded on highly conductive CNTs framework.[2] The incorporation of FGQDs onto the surface of CNTs led to a significant increase in the generation of H_2O_2, achieving an excellent selectivity of 88% and a faradaic efficiency of 80% towards the 2e- ORR. The FGQDs/CNTs electrocatalyst was further employed as the cathode for the home-made 2e- ORR/ZAB cell. The cell generated an open-circuit voltage (OCV) of about 1.46 V and achieved a maximum power density of approximately 24.09 mW cm-2. The characterization and electrochemical performance data provided in this study offer foundational insights for implementing FGQD/CNT in 2e- ORR/Zn-air batteries, making it possible to generate in-situ hydrogen oxide and electricity at the same time.

Abstract No. 0106 Li-Xin Huang

In recent years, solar energy has been widely utilized in photovoltaic cells; however, solar cells inherently face the challenge of intermittent power supply[1]. Research has begun integrating solar cells with energy storage devices to develop innovative photo-driven storage systems [2]. In this study, we designed a novel two-electrode based dye-sensitized photo-rechargeable ion capacitor (DSPIC), incorporating a reduced graphene oxide (rGO)-based bifunctional electrode to achieve DSPIC with outstanding performance for photovoltaic efficiency and storage capacity. rGO has excellent electrochemical properties, including high conductivity and a large surface area, making it widely applicable in photovoltaic devices and energy storage[3]. In Figure (a), DSPIC with rGO based CE achieves the conversion efficiency (η) of 1.72% and Jsc of 5.19 mA/cm2. For the charge/discharge test under illumination, as shown in Figure (b), the DSPIC with rGO based electrode sustained a stable photovoltage of 0.60 V within 1 minute under light illumination, which demonstrated the rGO-based electrode is more suitable for application in DSPIC than a Pt one.

Abstract No. 0107 Desalegn Yilma Kibret

Due to its low cost, good air stability, and excellent ionic conductivity (10−4─10−3 S cm−1), NASICON-type Li1+xAlxTi2-x(PO4)3 (LATP)-based composite solid electrolytes (CSEs) have attracted a lot of attention for next-generation all solid-state lithium metal batteries (ASSLMBs)[1]. Currently, the Li-metal battery (LMB) research groups have focused on the preparation of CSEs to take advantage of the complementary merits of inorganic fillers and polymer binders. In this particular work, a dry-processed thermal-extrusion was employed for the fabrication of CSE membranes using Li1.3Al0.3Ti1.7(PO4)3 (LATP), poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP), polyethylene oxide (PEO), succinonitrile (SN), and lithium bis(trifluoromethane sulfonyl)imide (LiTFSI). The presence of these blended polymer chains allows for the disruption of the polymer chain's regularity and the prevention of its reorganization, which leads to the creation of more amorphous structure domain and an increase in segmental motion inside CSE membranes. In addition, zeolitic imidazolate framework-8 (ZIF-8) and Al-doped LLZO have been applied as a buffer layer to overcome the chemical/electrochemical instability of LATP with Li-metal anode[2]. Consequently, the resulting CSEs exhibited high ionic conductivity (ca. 6.66 10–4 S cm–1), high electrochemical stability (4.89 V vs. Li/Li+), and excellent lithium transference number (ca. 0.74) at room temperature. On the other hand, our Li|CSE|Li symmetry cell cycled for more than 2000 h at 0.2 mA cm–2 without any increment in polarization potential or short circuit. Furthermore, the LFP|CSE|Li coin-type cell exhibited 80.46 and 99.11% of capacity retention and coulombic efficiency, respectively, after 550 cycles at 0.5C. Therefore, this approach can be viable for CSE preparation in ASSLMB applications.

Abstract No. 0108 **Chieh Li**

Dissolved oxygen (DO) is referred as non-conpound oxugen in liquids, whcich reflect the enviroment state. For example, excessive pollution can result in hypoxic water conditions with concentrations of DO below 4 mg/L[1, 2], which is harmful for living cell. Hence, DO sensing is being highly concerned in several industries cause it's a crucial indicator for aquatic statement. However, unfavourable biofouling from adherence of bacteria on sensor surface makes a serious effect to sensing signal. Copper has been used for sterilize and disrupt biofouling forming on the surface of sensor[3]. Protection of the copper nanowire (CuNW) network can achieve antibiofouling and keep gas exchanging efficiency. Inspired by Gore-Tex multilayer structure; an antibacterial protection layer is applied on gas exchanging membrane of electro-chemical DO sensor. As a result, the copper protection exhibits outstanding bacteria mortallity and maintain high sensitivity of 0.55 ± 0.03 μA ppm-1. Sensor with CuNW protection also demonstrate remarkable stability after 3 weeks of fouling test, which has little standard daviation on sensitivity of 2 × 10-4 (N = 3).

Abstract No. 0109 **Sylvia Ayu Pradanawati**

This research investigates the characteristics of Solid Polymer Electrolyte (SPE) with Polyvinyl Alcohol (PVA) as the host matrix. Sodium Sulfite (Na_2SO_3) serves as primary salt with an addition of various of cerium ionic radii additives: $Ce(OH)_4$, $Ce(SO_4)_2$, and $Ce(NO_3)_3$. Several tests were conducted on these samples, i.e.,X-Ray Diffraction (XRD), Fourier Transform Infrared (FTIR) spectroscopy, Thermogravimetric Analysis (TGA), and Electrochemical Impedance Spectroscopy (EIS) to evaluate the overall performance of the solid polymer electrolyte. The XRD data demonstrate that the sample with 5% cerium additives composition exhibits a higher amorphous phase than the sample with 1% cerium additives [1]. The FTIR test results show that the incorporation of $Ce(OH)_4$ cerium hydroxide salt the weakening the O-H bond in PVA. TGA shows that the incorporation of cerium additives fastens the thermal deterioration data indicates that incorporating cerium increases the glass transition temperature, emphasizes the amorphous characteristics and escalate the heat capacitance [2]. The EIS test indicates that the SPE sample containing 5% $Ce(OH)_4$ exhibits the highest ionic conductivity, measuring 6.414×10^{-5} S/cm.

Abstract No. 0110 YU-SHENG SHE

Anode-free lithium metal batteries (AFLMBs) offer significant advantages over conventional lithium-ion batteries (LIBs), including increased energy density, reduced weight, and simplified manufacturing processes. However, key challenges-such as direct deposition of lithium metal on the current collector can lead to non-uniform growth, dendrite formation, and electrolyte consumption. These issues lead to poor cycling stability, safety concerns, and reduced coulomb efficiency. A key factor in overcoming these challenges is the formation of a stable and effective solid electrolyte interphase (SEI) layer. This protective layer forms on the lithium metal surface during battery operation. An effective SEI can prevent direct contact between the lithium metal and the electrolyte, reducing side reactions and dendrite growth. Research efforts are focused on developing strategies to improve the properties of the SEI layer.[1][2] In this study, we considered two additives fluoroethylene carbonate (FEC) and 1,4-bis((trifluoromethoxy)methoxy)-2,5-di-tert-butylbenzene (TFMB) within the commercial electrolyte mixture consisting of LiPF6/EC/DEC. These mixtures, referred to as LiPF6/FEC/EC/DEC and LiPF6/TFMB/EC/DEC, are analyzed for their effects on interfacial reactions and SEI formation on the Li metal/Cu surface using Density Functional Theory (DFT) calculations coupled with ab-Initio molecular dynamics (AIMD) simulations. Through detailed Bader charge transfer analysis, we elucidate the electrolyte reduction mechanisms and compare the results with those obtained from the LiPF6/EC/DEC electrolyte mixture. Our results revealed a distinct preference for additive decomposition over solvents, effectively suppressing unwanted solvent degradation and facilitating the formation of desired SEI components. Specifically, the addition of TFMB enhances lithium fluoride (LiF) content in the SEI layer, improving its quality and stability. This theoretical study provides insights into optimizing electrolyte formulations to enhance the stability and performance of lithium-ion batteries.

Abstract No. 0111 Chih-Hsuan Liang

In recent years, tungsten carbide (WC) has emerged as an ideal electrode material due to its high hardness, high melting point, and excellent electrical conductivity, This study developed a novel method by synthesizing a catalyst solution from tungsten carbide and carbon powder, combined with coating technology to fabricate electrodes on carbon paper. This approach overcomes the limitations of traditional processes in terms of cost and catalyst distribution uniformity, successfully producing functional electrodes with low tungsten carbide loading.The research is structured into three key sections: (1) Exploring the effects of different catalyst ratios and tungsten carbide loading on electrode performance; (2) Analyzing the physical and chemical properties of the prepared tungsten carbide electrodes; (3) Optimizing coating parameters to enhance electrode performance and manufacturing reproducibility. The results show that adjusting coating parameters can significantly improve catalyst distribution uniformity and reduce manufacturing costs. the electrochemical performance was evaluated in both alkaline and acidic environments. Preliminary experimental results indicate that the electrode with a WC loading of 0.3 mg/cm² (prepared with 10 wt% WC/C and 1 wt% PBI) exhibits the best electrochemical performance under acidic conditions.

Abstract No. 0112 Qing-Yu Hu

The low reaction rate at the anode and the absence of a protective cathode electrolyte interphase (CEI) layer in lithium-ion capacitors (LICs) can be addressed by optimizing the electrolyte composition and solvation structure. Introducing lithium salts that form a boron-element protective layer, along with solvents that regulate the solid electrolyte interphase (SEI), is an advanced method for enhancing electrolyte formulations in LICs. Following this approach, we developed a co-solvent electrolyte (10T-FLE) composed of carbonate and cyclic ether solvents. This electrolyte incorporates LiBF4 combined with a solvent mixture of ethylene carbonate (EC), dimethyl carbonate (DMC), and diethyl carbonate (DEC), supplemented with 10 vol% tetrahydrofuran (THP) and 10 vol% fluoroethylene carbonate (FEC). The high donor number of THP effectively improves the solvation structure of LiBF4, while its interaction with LiBF4 and LiF on the anode surface promotes the breakdown of large LiF particles into smaller ones. This enhances the reaction rate at the anode and reinforces the uniformity and compactness of the SEI. The decomposition of LiBF4 at high voltages forms a boron-element-containing CEI layer, which effectively preserves LIC performance at high potentials. The use of LiBF4 also improves the high-temperature applicability of LICs. The stability of 10T-FLE is demonstrated by its ability to retain 79.0% of its capacity after 10,000 cycles at 30 °C and 86.8% at 60 °C. In terms of capacitance retention, 10T-FLE achieved 83.9% at 30 °C and 95.7% at 60 °C, highlighting its excellent performance under high-temperature conditions.

Abstract No. 0113 Chun-Hsuan Hsu

Developing bifunctional non-precious metal catalysts for the hydrogen oxidation reaction (HOR) and hydrogen evolution reaction (HER) in acidic environments presents considerable challenges, particularly for applications such as hydrogen purification, fuel cells, and water electrolysis. In this study, we introduce a CoSe2/CeO2 nanocomposite catalyst that has been electrochemically tuned to enhance its efficiency for HOR and HER in acidic conditions. This tuning process creates Ce3+, Co3+, and oxygen vacancies on the surface, which serve as active sites for hydrogen adsorption and desorption. The optimized catalyst (t-CoSe2/CeO2) exhibits outstanding performance in 0.5 M H2SO4, achieving an anodic current density of 1.8 mA cm−2 at 900 rpm and a cathodic overpotential of 61 mV, surpassing the performance of conventional Pt/C catalysts. Moreover, the catalyst demonstrates excellent stability in both reactions. These results suggest that manipulating the surface properties of CoSe2/CeO2 nanocomposites could provide a promising pathway for replacing precious metal catalysts in HOR and HER processes.

Abstract No. 0114 Andrei Bernadette

Ammonia, has traditionally been produced using the Harber-Bosch process involving harsh conditions. However, due to the high energy input, researchers have been exploring electrochemical NH_3 synthesis through (N_2)–water reactions under ambient conditions.[1] Despite this approach's potential, it currently faces challenges such as low yield rates and poor selectivity, due to the inertness of the N≡N bond.[2] To address these limitations, the developed environmentally benign electroreduction of nitrate to ammonia conversion have been studied. Enlightened by the selective nitrate reduction (NO_3–RR) of molecular Fe catalyst, herein we reported the Fe-Nx sites of the immobilized molecular Fe on NGQDs. The conjugation between the molecular Fe and NGQDs had exposed the molecular Fe-Nx coordination that played critical role in the NO_3–RR as shown by the XAS result (Fig. 1a). Moreover, the operando Raman spectroscopy unveiled the dynamic nature of the Fe-Nx active sites during the NO_3–RR (Fig. 1b). The Fe-Nx molecular catalyst enables maximum Faradaic efficiency of 93% at -0.8 V (Fig. 1c) with a high yield rate 5.41 mmol h^{-1} cm^{-2}, leading to the high selectivity for the NO_3–RR.

Abstract No. 0115 Sung-Chuan Kao

NMC811, as a high-nickel-content cathode material for lithium-ion batteries, exhibits high energy density and excellent rate performance, making it widely used in electric vehicles and energy storage systems. However, the research on its electronic and ionic transport properties under different states of charge (SOC) and temperature conditions remains limited, despite these properties being crucial for optimizing battery performance. In this work, electrochemical impedance spectroscopy (EIS) was used to systematically analyze the electronic conductivity and lithium-ion diffusivity of NMC811 across various SOCs and temperature ranges. This provides new insights for the design and optimization of lithium-ion battery materials, aiding in improving both energy density and power output performance.

Abstract No. 0116 Yi-Rong Li

Coffee contains many substances, which are potentially biologically active. Amongst, chlorogenic acid (CGA), and caffeine (CAF) are polyphenolic compounds, that are involved in many physiologic effects on the consumption of coffee. CGA acts as an antioxidant, anti-aging, maintains blood pressure, regulates glucose, induces body fat loss, and has many other beneficial roles in human health. Additionally, CAF acts as a stimulant for circular systems, the central nervous system, muscles, heart, and circular systems of the human body. Moreover, it accelerates exercise performance, learning capacity, and alertness. However, the overdose of CGA causes serious health issues including vomiting, dermatitis, inflammation reactions, and nausea. Similarly, excessive levels of CAF may lead to insomnia, loss of appetite, gastrointestinal problems, agitation, hypertension, irritability, fever, delusions, tachycardia, and even death. Therefore, it is necessary to monitor the level of both CGA and CAF. There are many other methods including HPLC to detect both the polyphenols which are costly and difficult to handle. On the other hand, electrochemical sensing is easy to handle, cost-effective, rapid detection, and portable. Here, we have developed a biosensor using zincophosphite metal-organic frameworks (MOFs) denoted as NCU to modify screen-printed carbon electrodes (SPCEs). NCU was synthesized using a solvothermal method, characterized through XRD, and FTIR. The microporous structure, excellent conductivity, and abundant active sites of NCU attract for the electrochemical study. The electrochemical catalytic properties of modified electrodes were analyzed by the Differential pulse voltammetry (DPV) method. The NCU/SPCE was significantly sensitive for the detection of CGA, and CAF at the potential of 0.15 V, and 1.4 V, respectively. The biosensor exhibits a wide linear range for CGA from 0.25 mM to 0.6 mM with a limit of detection (LOD) of 0.16 mM. In addition, the modified electrodes have demonstrated a wide linear range from 1.6 mM to 4.5 mM for CAF detection with a LOD of 0.007 mM. This study may pave the way to use the MOFs modified electrodes at the commercial level to enhance the detection of polyphenols at coffee in the field of food safety applications.

Abstract No. 0117 張家瑜

Phthalocyanine (PC) possesses a unique N4-coordinated structure that naturally accommodates metal ions, making it well-suited for addressing the typical challenges of single-atom electrocatalysts, such as low metal loading and poor stability. In this study, we introduce a versatile synthesis approach using electrochemically-generated templates and cationic substitution to fabricate high-loading dual single-atom catalysts (DSACs), achieving a metal loading of approximately 8.6 wt% from commercial copper phthalocyanine (CuPC). During electrochemical potential cycling, most CuPC is converted into Cu nanoparticles, leaving behind vacant N4 sites. These negatively charged sites exhibit a strong affinity for capturing Pd^{2+} ions from a precursor solution, leading to the formation of DSACs with high Pd loading.

We explored the structural transformation and cationic substitution mechanisms using in situ X-ray absorption spectroscopy (XAS). This electrochemical template-based synthesis also holds potential for fabricating other high-loading transition metal single-atom catalysts, including Ni, Co, and Fe. In bimetallic systems, the synergistic interaction between two metals further enhances catalytic performance. To validate the catalytic efficiency of these single-atom electrocatalysts, we employed the electrochemical reduction of CO_2 as a model reaction. The predominant products were CO and H_2, with liquid products constituting less than 10% within the examined potential range, demonstrating excellent selectivity. At −0.7 V, the Faradaic efficiency for CO surpassed 60%. Additionally, these DSACs significantly improve electrocatalytic performance in the ethylene glycol oxidation reaction, exhibiting exceptional glycolate selectivity (over 88%) in alkaline solutions. The onset oxidation potential was as low as 0.6 V versus the reversible hydrogen electrode (RHE), outperforming commercial Pd/C catalysts. Overall, our findings propose a promising strategy for synthesizing DSACs with various transition metals, offering a pathway toward the development of highly efficient, selective, and environmentally sustainable catalysts for a broad range of applications.

Abstract No. 0118 Jia-Jun Ye

This study proposes a synthetic strategy of zinc manganese oxide/carbon nanocomposites as electrode materials by the electrodeposition approach for supercapacitors, next explore the differences in electrochemical capacitive properties. The morphology, surface chemical composition, and structural definition of the samples were characterized by field emission scanning electron microscopy (FESEM), transmission electron microscopy (TEM), Raman spectrometer, and X-ray photoelectron spectroscopy (XPS), which provide in-depth investigations into the impact of changes in the electronic configuration, surface morphology, and crystal structure of zinc-manganese oxide/carbon nanocomposites on the energy storage mechanism of supercapacitors. The above results reveal that the electrodeposition approach with the effect of Zn/Mn precursor concentration in zinc manganese oxide/carbon nanocomposites have significant influence on the morphological and structural characterizations, and thus greatly affect the electrochemical performance of supercapacitor.

Abstract No. 0119 Yang-Ming Lu

"With the increasing demand for energy storage in hybrid electric vehicles and portable electronic products, supercapacitors have become one of the research focuses of the scientific community. Supercapacitors can provide high-speed charging and short-term power supply, and are a highly forward-looking and practical power source. This study uses copper oxide (CuO) with a high theoretical specific capacitance value as the base material, and then combines molybdenum disulfide (MoS2) as the material to form a binary composite material. Since molybdenum disulfide has unsaturated sulfur atoms coordinated at the edge of the structure, it has a large number of active sites, and its large surface area is easy to functionalize with other groups such as graphene and metal oxides. Therefore,addition of molybdenum disulfide is expected to enhance the performance of copper oxide capacitors.

In this study, copper oxide synthesized by a low-temperature hydrothermal method and molybdenum disulfide synthesized by a thiourea-free process were mixed through direct stirring to form a copper oxide and molybdenum disulfide composite material. Explore the effects of different proportions of copper oxide combined with an appropriate amount of molybdenum disulfide on supercapacitor characteristics. The capacitance characteristics were measured using electrochemical cyclic voltammetry.

The results of this study show that adding an appropriate amount of molybdenum disulfide to copper oxide can effectively improve capacitance performance. When the molar ratio of copper oxide and molybdenum disulfide is 2:1, it performs better than the molar ratio of 1:1. The specific capacitance value can reach 124F/g, which can be effectively increased by about 1.2 times."

Abstract No. 0120 Lian-Ming Lyu

Hydrogen presents significant potential for the conversion and storage of renewable energy sources like solar and wind power, primarily through the process of water splitting. A major challenge in water splitting, however, is the oxygen evolution reaction (OER), which requires the breaking of two O-H bonds and the formation of an O-O bond via a complex four-electron transfer process. In recent years, noble metal-based catalysts such as RuO_2 and IrO_2 have demonstrated excellent catalytic performance, but their high costs limit widespread adoption. To address this issue, researchers have turned their attention to pyrite-type transition metal dichalcogenides, which offer metallic conductivity, abundant availability in the Earth's crust, and customizable properties. In this study, we utilized a hydrothermal approach to synthesize core-shell CoS2-FexCo1-xS2 nanooctahedra at scale. Our results showed that this catalyst achieved catalytic activity comparable to that of commercial RuO_2.

Abstract No. 0121 Kang-Shun Peng

Electrochemically converting carbon dioxide (CO2) into valuable multicarbon products by electrocatalysis, such as ethylene and ethanol, has drawn attention recently because it can decrease CO2 in the atmosphere effectively and create economic value. Copper is the only catalyst capable of producing multicarbon products but still shows poor selectivity under a high current density. To resolve this problem, in this study, we developed a copper-aluminum alloy enclosed inside the carbon nanofiber. Carbon nanofibers with a larger diameter provide good carbon dioxide permeability, conductivity, and a well-defined spatial confined environment, concentrating CO* intermediates. Copper-aluminum alloy can regulate the 3d orbitals of the active sites, enhancing the overall catalytic activity. X-ray absorption spectroscopy and resonant inelastic X-ray scattering enable us to observe the alteration in 3d orbitals of copper by aluminum, confirming aluminum changing the electronic structure and improving the copper for carbon dioxide reduction reactions. Our developed electrocatalyst achieves the Faradaic efficiency of 72.13% toward C2+ products under the operating current density of 1200 mA/cm2 and the partial current density of 926.52 mA/cm2. It overperforms the pristine copper, whose C2+ Faradaic efficiency is 72.00% under the operating current density of 200 mA/cm2 and the partial current density of 144 mA/cm2. We hope our results can provide insightful information for industrial development of carbon dioxide reduction reaction, aiming to reduce carbon dioxide emissions and contribute to the well-being of our planet.

Abstract No. 0122 Satoshi Uchida

Recently, there has been a surge of interest in organometal halide perovskite solar cells (PSCs). These cells have exhibited a remarkable increase in power conversion efficiency (PCE), with certified PCEs reaching over 26% by employing mixed organic cations and halide anions. The PCE is significantly influenced by the photovoltaic properties of each component within the PSC. Despite the crucial role of crystallographic information, micro-structural analysis of the perovskite layer has not been extensively pursued. The micro-structural observation analysis of the perovskite layer with high resolution TEM is the most promising approach to understand the crystal structure. Organometal halide perovskites demonstrate a remarkable ability to self-adjust their micro-structural configurations and self-organize buffer layers inside crystals or at hetero-interfaces by introducing self-assembled superlattices. We believe that this report represents a pivotal advancement, bringing PCEs of organometal halide perovskite solar cells closer to their theoretical maximum and redefining the potential of these materials for a wide range of applications beyond solar cells.

Abstract No. 0123 Ci-Rong Deng

Technological advancements have improved quality of life but often at the cost of environmental harm from manufacturing waste. An urgent issue is the need for eco-friendly production, particularly in energy storage. Current lithium-ion batteries, with energy densities of 100-250 mAh g^{-1}, are insufficient for modern needs and have costly, harmful raw materials. Lithium-sulfur batteries, with a theoretical capacity of 1675 mAh g^{-1}, offer higher energy density and use sulfur, an abundant, eco-friendly material. This research investigates using waste materials like discarded hand warmers and desulfurization by-products from the Dalin Refinery as cathode materials for lithium-sulfur batteries. By recycling waste, we move towards more sustainable energy solutions. Despite their benefits, lithium-sulfur batteries face challenges such as poor conductivity and soluble polysulfides that damage electrodes and reduce cycle life. This study addresses these issues by incorporating recycled wasted hand warmer that is explored to have activated carbon, iron (II,III) oxide, and vermiculite, which are idendified for the functions of improving conductivity, enhance polysulfide adsorption, and charge transfer (Figure 1a). This approach results in excellent cell performance with initial discharge capacities of around 800 mAh g^{-1} over 100 cycles (Figure 1b) and promotes waste reuse, reduced chemical by-products, and sustainable energy storage solutions.

Abstract No. 0124 Manoj Kumar Senniyappan

Over the technological improvements, sodium-ion batteries (SIBs) have been recognized as promising alternatives to lithium-ion batteries (LIBs) in electrochemical energy storage (EES) applications. In alkaline metal-ion battery communities, the commonly used electrolytes are based on ester solvents due to their fascinating decomposition resistance at a high operation potential compared to ether ones. Herein, a biphasic Na3V2(PO4)3/Na3V3(PO4)4 cathode material was adopted as an example to evaluate its cyclability using 1 M NaPF6/diglyme as the electrolyte and in the potential range of 2.0 to 4.3 V (vs. Na/Na+). Upon the galvanostatic cycling tests, the reversible capacity delivered from such a combination was 96 mAh/g at 0.5 C. Encouragingly, remarkable rate capability (84 mAh/g at 10 C), less polarization (34 mV at 0.5 C vs. 186 mV at 10 C), and outstanding cyclability (capacity retention: 93 % at 10 C after 2,500 cycles with >99.5% of Coulombic efficiency) were also achieved. These impressive results verified that the electrolyte used in the present study was highly stable even at a cut-off potential of up to 4.3 V (vs. Na/Na+). Consequently, diglyme could be utilized as a promising solvent to prepare the electrolyte for high-voltage SIBs.

Abstract No. 0125 **Yu-Chong Lin**

Secondary aqueous Zn-ion batteries have been garnered much attention recently due to low cost, high safety, and environmental friendliness. Among cathode materials, vanadium oxides have been widely investigated due to high capacity and good cycle life for Zn2+ storage. AgVO3 has been used in Li-ion batteries, showing unique electrical properties and high specific capacity [1-2]. Despite that, this material has never been evaluated in aqueous Zn-ion batteries. Herein, we reveal that both α- and β-AgVO3 polymorphs exhibit redox behaviors in aqueous Zn-ion batteries. In particular, electrochemical activation can be observed for α-AgVO3, and the initial discharge capacity reaches 216 mAh g-1, and the specific capacity increases from 113 mAh g-1 to 153 mAh g-1 after 50 cycles. For β-AgVO3, the initial capacity reached 215 mAh g-1. After 50 cycles of testing under the same conditions, the specific capacity remained only 138 mAh g-1.

Abstract No. 0126 **Cindy Rusly**

The global shift towards electrification, driven by climate change mitigation efforts and international agreements like the Paris Agreement, has significantly boosted the sales of hybrid electric vehicles (HEVs). In turn, the utilization of nickel-metal hydride (NiMH) batteries is accelerated, and this rapid expansion has posed new challenges, particularly in management of spent NiMH batteries as HEVs reach the end of life. NiMH batteries contain valuable metals such as nickel, cobalt, and rare earth elements (REEs), thereby, an efficient recovery of these materials is crucial to minimize the environmental impact of resource mining. Despite the importance of recycling these materials, existing technologies for NiMH battery recycling remain underdeveloped compared to those for Li-ion batteries, highlighting the urgent need for improved methods.

This research focuses on optimizing recycling techniques for NiMH batteries to recover valuable nickel-manganese-cobalt (NMC) electrode precursors. By employing a hydrometallurgical process, which utilizes sulfuric acid to extract valuable REEs in sulfate form, followed by co-precipitation to produce NMC electrode precursors, we aim to enhance the efficiency and effectiveness of material recovery. The leaching efficiency, recovery rate, and purity of the recovered materials will be analyzed by using Inductively Coupled Plasma (ICP) and Energy Dispersive Spectroscopy (EDS). SEM analysis is also employed to analyze the morphology of the recovered materials. Our work seeks to advance NiMH battery recycling technology, contributing to a circular economy and providing a scalable solution to the environmental challenges posed by the increasing adoption of HEVs.

Abstract No. 0127 Yang-Ming Lu

Due to the increasing demand for industrial electricity, the world is facing an energy crisis. To address this issue, developing efficient energy storage devices is necessary to meet the challenge. Supercapacitors have attracted significant attention for their high power density and fast charge/discharge rates. Copper oxide (CuO) possesses a high theoretical specific capacitance, and this study aims to modify the pseudocapacitive properties of CuO by controlling its morphology to change the specific surface area. Furthermore, combining CuO with reduced graphene oxide (rGO) can address the limitation of poor conductivity in pure metal oxides, potentially further enhancing the supercapacitor properties.

In this study, three different morphologies of CuO were synthesized using a hydrothermal method, and graphene oxide was synthesized using an improved traditional Hummers method. The CuO nanomorphology with the highest specific capacitance was selected and combined with reduced graphene oxide through a direct mixing method. The specific capacitance of the composite material was measured using electrochemical cyclic voltammetry. The objective of this research is to explore the impact of different CuO nanomorphologies on supercapacitor performance and observe whether the addition of reduced graphene oxide further enhances electrochemical properties.

This study found that under a charge/discharge condition of 1 A/g, the specific capacitance of CuO nanospheres was approximately 107 F/g, superior to that of CuO nanosheets (100 F/g) and CuO nanorods (82 F/g). Building on these results, the composite material made from CuO nanospheres, which had the highest specific capacitance, and reduced graphene oxide achieved a capacitance of 128 F/g, representing an enhancement of about 1.2 times.

Abstract No. 0128 Yin-Li Wang

Lithium-ion batteries (LIBs) are essential for mobile electronics, electric vehicles, and energy storage systems due to their high energy density, long lifespan, and lightweight properties. However, challenges like safety concerns and charge-discharge limitations remain. As clean energy demand grows, advancements in cathode materials, especially LiFePO4 (LFP), are critical for improving battery performance. This study focuses on synthesizing a composite cathode material for LFP-based batteries to enhance electrochemical properties and resolve solid-solid interface issues with solid electrolytes. Using a sol-gel method, Li1.3Al0.3Ti1.7(PO4)3 (LATP) powder was integrated into a LATP/PVDF-HFP composite electrolyte membrane. The optimal composition included 70% LFP, 10% Super P, 10% KS-4, and 10% PVDF, with an additional 38.8% PVDF-HFP electrolyte. The final LATP/PVDF-HFP electrolyte layer (22% PVDF-HFP, 33% LiTFSI, and 45% LATP) improved electrochemical performance, thermal stability, and having an ionic conductivity of $4.1\times10^{-}3$ S cm^{-}1. The optimized cathode exhibited a higher discharge capacity of 161.12 mAh g^{-}1 at 0.1C with a wide electrochemical window, showcasing its potential for high-performance solid-state LIBs.

Abstract No. 0129 Le-Yen Lin

"The prediction of charge carrier chemistry and mixed ion-electron transport phenomena in battery electrodes is crucial for battery electrodes. However, conventional theoretical predictions [1-3] often encounter limitations when applied to realistic electrode architectures, which involve multi-phase composites comprising electroactive materials, solid electrolytes, and electronically conductive carbon. Challenges in predicting charge transport kinetics and carrier chemistry stem from the sophisticate electrode microstructure and the presence of heterointerfaces among constituent materials. To address these challenges, we employ the finite element method to establish a charge transport model capable of characterizing the transport kinetics and carrier chemistry of composite electrodes. Through simulations of electrochemical impedance, we identify electrical and chemical transport phenomena in the composites, interpreting them via the generalized transmission line model. We also underscore the critical roles of heterointerfaces' selectivity and the influence of particle size on the transport process. Furthermore, through visualization of concentration propagation during battery discharging, we elucidate the impacts of ionic and electronic networks, as well as the contact issues between each constituent in the composite electrode. Our work paves the way for understanding and predicting the behavior of mixed ion-electron transport in complex electrochemical systems, while also offering guidelines for rationally designing electrode architectures in batteries.

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Abstract No. 0130 Jia-He Peng

In response to the 2050 net-zero carbon emission goal, hydrogen production via electrolysis is one of the feasible strategies. The development of efficient and low-cost catalysts is key to the success of hydrogen production through electrolysis. In this study, a series of environmentally friendly, one-step, highly active, long-lasting, non-precious metal-based electrocatalyst materials were developed using metal-organic frameworks (MOFs). The study explored how the structural differences between two-dimensional and three-dimensional MOFs, formed by two different ligands, result in distinct catalytic trends depending on the metal adaptation. A urea-containing solution was selected as the electrolyte, as electrolysis of urea solution significantly reduces energy consumption and costs compared to traditional water electrolysis [1], while increasing hydrogen yield and purifying urea pollutants. The bimetallic, dual-ligand TD-Ni0.6Co0.2/NF developed in this study exhibited excellent performance in the urea oxidation reaction (UOR), requiring only 1.341 V and 1.369 V (vs. RHE) at 10 and 100 mA cm-2, respectively, with overall reactions at 1.408 V and 1.634 V. In chronoamperometry testing, the total duration exceeded 1,750 hours, with only about a 6.2% increase in potential.

Abstract No. 0131 Liang-Ting Wu

Developing electrolytes for Li-metal batteries (LMBs) with long-term cycling stability and high specific capacity is a major challenge, often due to the lack of systematic solvent screening. The continuous consumption of reactive Li-metal through the formation of inactive Li and solid electrolyte interphase (SEI) results in low Coulombic efficiency and poor capacity retention. To address this, we previously investigated bubble point, eutectic temperature, salt solubility, and ion-binding energy of binary solvent mixtures from a thermodynamic perspective. In this study, we expand the electrolyte screening by calculating electrochemical properties, such as redox potential and reorganization energy, for 23 solvents using density functional theory (DFT). This allowed us to evaluate charge transfer from both thermodynamic and kinetic perspectives. We also applied machine learning to analyze how HOMO/LUMO levels, dipole moment, and polarizability correlate with redox potential. Our findings show that, in addition to frontier orbitals, solvent polarizability is key to predicting redox potential. Lastly, we used ab initio molecular dynamics (AIMD) simulations to explore interfacial reactions between solvents and the Li-metal anode, predicting potential SEI components. These results offer valuable insights for designing improved electrolytes for LMBs.

Abstract No. 0132 Shu-Hao Chang

Secondary batteries are becoming increasingly important in our daily lives. To achieve high energy density and greater stability in lithium-ion (LIB) and zinc-ion batteries (ZIB), anode treatments play a crucial role. By introducing protective layers on the anode surface, such as metal oxides or other inorganic materials, we can reduce dendrite growth and inhibit side reactions during charge and discharge cycles. These treatments enhance the structural integrity of the anode, minimizing degradation and extending the battery lifespan. In our research, we employed non-vacuum deposition techniques to apply a protective layer onto copper anodes, followed by lithium-ion or zinc-ion deposition. Symmetrical cell and full-cell electrochemical tests demonstrated improved performance and long-term stability in both lithium-ion and zinc-ion systems.

With the rapid pace of industrialization and urbanization, environmental concerns have become increasingly severe, with carbon dioxide (CO2) being a major contributor to the greenhouse effect. Hence, it is urgent to develop effective strategies for mitigating CO2 emissions and alleviating their impact on global warming. The carbon dioxide reduction reaction (CO2RR) has gained attention as a promising approach, not only to lower atmospheric CO2 levels but also to sustainably produce value-added fuels and chemicals. However, the CO2RR still faces several challenges, including competition with hydrogen evolution reaction (HER), high overpotentials, low product selectivity, and Faradaic efficiency. Thus, there is an urgent need to identify highly active and selective electrocatalysts to improve the efficiency and viability of CO2RR processes. In this study, we used an eco-friendly semiconductor photocatalytic material g-C3N4 to evaluate its catalytic performance in CO2RR using density functional theory (DFT) calculations. Building on our previous research, which explored metal-decorated g-C3N4 materials such as Fe@g-C3N4, Co@g-C3N4, and Pd@g-C3N4 for CO2 conversion to CO, we found that Fe@g-C3N4 is the most promising catalyst, exhibiting the lowest energy barrier of 0.72 eV.[1] Herein, we first performed a detailed comparison between pristine g-C3N4 and Fe@g-C3N4, utilizing Bader charge analysis, and electron density difference mapping to understand how iron affects the electronic properties of CO2. Fe@g-C3N4 is then employed as the catalyst to assess its electrocatalytic performance in CO2RR. Our findings demonstrate that Fe@g-C3N4 exhibits strong electrocatalytic activity, effectively reducing CO2 into C1 products such as formic acid and formaldehyde. Notably, formic acid emerged as the primary product, with the reaction pathway showing the lowest limiting potential of 0.70 V, indicating its potential for industrial applications. To validate these findings, we performed additional calculations using the Quantum Espresso package, confirming the reliability of the predicted reaction pathway and product selectivity. This study highlights the potential of Fe@g-C3N4 as a highly efficient catalyst for CO2 reduction and provides valuable insights into developing sustainable CO2RR technologies to address environmental challenges.

Abstract No. 0134 Jui-Hung Chen

Compared to lithium-ion batteries (LIBs), anode-free lithium-ion batteries (AFLIBs) offer advantages like lower cost and higher safety, making them a promising energy storage system. AFLIBs use only copper foil as the anode current collector, resulting in higher energy density. However, dendrite formation and dead lithium generation remain major challenges, affecting cycling efficiency and battery lifetime.[1] This study focuses on improving AFLIB cycling efficiency by modifying the current collector surface to reduce dead lithium.

In our research, we selected a carbon-based two-dimensional material (2DG) for in-depth investigation. Using the Chemical Vapor Deposition (CVD) method, we synthesized a 2D G film on the surface of the current collector to reduce surface energy and improve cycling efficiency. After measurement, the modified copper foil showed significantly reduced overpotential during lithium plating, decreasing from −47.1 mA to −20.1 mA, indicating that the modified current collector effectively reduced surface energy. In long-term cycling, the modified current collector demonstrated excellent stability, maintaining an overpotential of approximately 6−-10 mV during 1000 h of lithium plating-stripping tests, while the unmodified collector exceeded 5000 mV at 206 hours, showing that the modified collector effectively reduces dead lithium formation.

Subsequently, AFLIBs were assembled using LiFePO4 as the cathode and copper foil as the current collector. In terms of battery capacity, the modified copper foil showed a 12% improvement in initial discharge capacity compared to the unmodified copper foil, and the capacity decay rate was also reduced. These results indicate that 2DG-modified current collectors are suitable for use in AFLIBs.

Abstract No. 0135 **Sanna Gull**

"Despite the simplicity and widespread use of conventional (untreated) Zn foil as a benchmark, conventional Zn foil remains the most common anode material in zinc-ion batteries (ZIBs) research. However, little attention has been paid to the inherent structure of the zinc foil itself. Traditional Zn anodes possess uneven, rough surfaces, leading to non-uniform charge distribution and nucleation barriers, which can trigger detrimental dendrite formation due to the “tip effect”. This study examines the impact of simple pre-treatments, such as mechanical polishing and chemical etching, on Zn foil anodes. These treatments significantly enhance the plating/stripping cycle life of Zn foil electrodes, markedly improving ZIB performance. For practical applications, we tested full cells using bare Zn (b-Zn), mechanically polished Zn (p-Zn), and chemically etched Zn (e-Zn) within the potential range of 0.2 to 1.6 V. Compared with the b-Zn and p-Zn, e-Zn sustained a remarkable life cycle of up to 5000 cycles with ~71% cycling retention at a high current density of 5 A g−1 using V2O5.nH2O as a cathode material. Besides, the e-Zn||e-Zn symmetric cell exhibited excellent cycling stability over 300 cycles at a high current density of 10 mA cm−2 with better inhibiting hydrogen production during Zn stripping/plating. Moreover, advanced characterizations such as in situ transmission X-ray microscopy (TXM) and ex-situ atomic force microscopy (AFM) have been employed to gain insight into the early stages of Zn dendrite formation on Zn foils in mild acidic aqueous electrolytes during the plating/stripping processes. This superior performance of the e-Zn is attributed to its unique 3D structure that effectively accommodates Zn dendrites, as confirmed by XRD and electron backscatter diffraction (EBSD) analyses, which reveal Zn deposition along the (002) plane with lower surface energy as compared with other planes. This approach provides a straightforward and industrially scalable method for expanding ZIB utilization."

Abstract No. 0136 Meng-Fei Wu

Electrochemical capacitive deionization (ECDI) is considered an energy-efficient technique with environmental friendliness for salt removal from brackish water and water softening. Recently, the development of nanostructures via the hybridization of carbon materials with various pseudocapacitive materials as composite electrodes has been extensively explored in various deionization systems. In this work, we have achieved the customizability of the phase composition and crystallinity of MnOx /activated carbon (AC) composites by tuning the intrinsic properties of the carbon substrate and applied these composite electrodes to membrane-free ECDI systems for a comprehensive study. The amorphous birnessite-type MnO2@AC electrode, characterized by a larger specific surface area and a higher pore size gradient, is particularly conducive to the insertion and extraction of Na+ ions. Therefore, compared with the crystalline Mn3O4@AC electrodes, the amorphous MnO2@AC electrodes exhibit better electrochemical performance in CV, GCD and EIS analyses. Consequently, the constructed MnO2@AC//PPy@AC ECDI system exhibits enhanced desalination performance, achieving a removal capacity of up to 61.4 mg g-1 and a high removal rate in an 8 mM NaCl solution. Moreover, it demonstrates excellent cycling stability, retaining 97% of its salt removal capacity (SRC) over 150 cycles, whereas the Mn3O4@AC systems show an inferior SRC retention of 60-70%. The degradation mechanisms of these systems were further explored through material characterization. This study evaluates the impact of morphological and phase composition of MnOx on the electrochemical and desalination behavior, which is crucial for the rational design of high-performance composite electrode materials for practical applications in membrane-free ECDI systems.

In lithium-ion batteries (LIBs) the solid–electrolyte interphase (SEI) layer, which forms on the anode surface, plays a crucial role in stabilizing battery performance.[1] Over the past two decades, efforts to enhance LIB electrolytes have primarily focused on refining the quality of SEI components. Despite these endeavors, several observed phenomena remain inadequately improved the SEI layer. Consequently, there has been a significant surge in research interest regarding the behavior of electrolyte solvation structures to elucidate improvements in battery performance. Thus, in this study, we aimed to explore the solvation structures of LiPF6 in a mixture of organic solvents, tetrahydrofuran (THF) and 2-methyl-tetrahydrofuran (MTHF) using ab-initio molecular dynamics (AIMD) simulations. Our work investigated the solvation structure of electrolytes with different salt concentrations: low-concentration electrolyte (1.0M LiPF6 in 1:1v/v mixture of THF and MTHF), and high-concentration electrolyte (2.0M LiPF6 in 1:1v/v mixture of THF and MTHF) and compared them with that of conventional electrolyte (1.0M LiPF6 in 1:1v/v mixture of ethylene carbonate (EC) and dimethyl carbonate (DMC)). We analyze the reduction stability of Li+ solvation structures in in each system and examine their impact on SEI formation and battery performance. Our results reveal that the first solvation shell of Li+ primary consists of THF molecules. Additionally, molecular orbital analysis shows that the THF/MTHF-containing electrolytes exhibit a higher lowest unoccupied molecular orbital (LUMO) energy level compared to the commercial electrolyte, indicating improved reduction stability and enhanced interface properties. Previous studies have demonstrated that the use of Li-Al alloys significantly enhances cycle life and facilitates the formation of a more stable and denser SEI layer. Building on these insights, this study aims to investigate the solvation structures of the constructed electrolyte systems on the surfaces of both pristine lithium (Li) and Li-Al alloys through AIMD simulations. Additionally, we employ Bader charge analysis to trace the electron transfer at the interface, providing a detailed understanding of the sequence of reduction reactions that lead to SEI formation. The results of this study will offer critical insights into how Li-Al alloy anodes improve the cycling stability of lithium metal batteries, highlighting strategies for optimizing SEI layer formation and improving lithium metal battery performance.

In this study, a low-temperature (<300°C) and high-efficiency (10 min) MW-PECVD (microwave plasma-enhanced chemical vapor deposition, [1]) synthesis approach was used to grow the vertically oriented, high-defect-density, and few-layers Nano-Porous Cypress-liked 3D Graphene (NPCG). NPCG was employed as a conductive additive in activated carbon (AC) based electrodes, aiming to encapsulate coin cell supercapacitors in organic electrolytes. Comparing with commercially available conductive carbon blacks, NPCG possesses its advantages and disadvantages in terms of electrochemical performances, which were comprehensively investigated in this work.

By means of electron microscope images, electrode with NPCG incorporated formed directional clusters constructing monolithic ion diffusion paths, which effectively enhance the response of high-rate current density performance (30 A/g) as shown in Figure 1(a). Moreover, the highly defective porous structure of NPCG@60 W was utilized to enhance electrode's hydrophilicity (Figure 1(b), (c)), resulting in reduced IR drop and interfacial charge transfer impedance (Rinter) in supercapacitors in Figure 1(d).

Most importantly, the proposed AC carbon-based electrode mechanism is favorable for reducing agglomeration due to the morphological defects in the conductive additive, as well as the structural size of the filled voids. This will effectively increase the supercapacitor's optimal specific capacitance value to 156.33 F/g at 0.1A/g as presented in Figure 1(a). Additionally, the 5.0 NPCG exhibits 89.9% retention after 10,000 cycles (Figure 1(e)), along with an impressive high energy density of 135.9 Wh/kg and power density of 57,675.0 W/kg, making NPCG material a promising candidate as a conductive additive in non-aqueous EDLCs for advanced energy storage applications as the comparison demonstrated in the Ragone plot in Figure 1(f).

Abstract No. 0139 Chun-Yen Yang

Metal-organic frameworks (MOFs) constitute a class of porous materials comprising inorganic metal nodes and organic ligands. Due to their designable chemical and structural diversity, MOFs have recently demonstrated high tunability in controlling the functionalities of electrodes, thereby paving the way for the development of fast-charging batteries. In this contribution, we present a novel class of MOFs based on the ligand bis(2-hydroxyethyl) terephthalate (BHET), exhibiting anomalous behavior in lithium storage in response to insertion reactions. In contrast to conventional battery materials, which often suffer from degradation in storage capacity, BHET-based MOFs exhibit a distinctive behavior wherein significant growth in charge storage is observed even after hundreds of cycles of lithium insertion and extraction. This anomalous phenomenon of charge storage indicates an electrochemically self-activated reaction occurring in BHET-based MOF electrodes.

X-ray diffraction characterization reveals a dramatic structural transformation, turning the MOF structure from well-crystalline to amorphous during (de)lithiation processes. Furthermore, an investigation using transmission X-ray microscopy (TXM) demonstrates the evolution of pore construction during battery cycling. These structural characterizations, in conjunction with the redox of metal node ions studied by X-ray absorption spectroscopy (XAS), represent that the microstructural transformation of BHET-based MOFs drives the self-activation reaction, leading to the anomalous growth of charge storage capacity within each cycle. Additionally, we observe a transition in the storage mechanism of BHET-based MOF electrodes, initially involving bulk-type intercalation reaction and eventually shifting to an interface-type pseudocapacitive storage mechanism. These findings not only elucidate the complex storage mechanism in MOF-based materials but also shed light on the design of high-performance and long-lasting batteries.

Abstract No. 0140 Chun-Hao Huang

Developing high energy-density lithium ion batteries (LIBs) with SiOx-C anodes (>500 mAh/g) has drawn researchers' attention worldwide in response to the increasingly urgent need for high-mileage EVs. Despite all the merits from the SiOx-C anodes, what came along is the inevitable tendency to come off from the copper foil due to volume expansion after long cycles. One of the solutions to mitigate this phenomenon is to introduce a thin carbon layer between the copper foil and the SiOx-C anode layer, which has been proven effective by plenty of research as well as the commercialization of carbon-coated copper foil.

Based on years of dedication on developing carbon-based materials, such as artificial graphite and soft carbon for anodes in LIBs, CPC set out to expand its field of research to a new category, graphene, in recent years. In this study, commercially-available expandable graphite is used as the precursor, and a four-step process flow with cost-efficiency and scalability for (multi-layered) graphene production has been established, including thermal expansion, patented milling by convection, sieving and thermal recovery. Satisfactory parameters are obtained from the as-produced graphene powder, such as a d50~15μm, a BET specific surface area value of ~30 m2/g, a low ID/IG value of 0.09, and a stable NMP dispersion after a 3-day storage. Parameters in the forthcoming steps, such as the dispersion process flow, graphene coating on copper foil and home-made SiOx-C coating on graphene layer, will be optmized and electrochemical performance improvement will be evaluated. In the next study, CPC home-made artificial graphite will be introduced as the carbon source to produce expandable graphite, in an aim to improve the morphology, reduce impurities and obtain a fewer-layer, higher-quality graphene powder.

Abstract No. 0141 Jia-Ru Lin

The increasing concentration of carbon dioxide (CO_2) globally, driven by industrial development, has made CO_2 reduction a critical area of research. Metal catalysts are commonly employed for CO_2 reduction through catalytic reactions. Among these, copper stands out due to its various advantages, including low cost, wide availability, and high electrical conductivity. This study focuses on the fabrication of copper-based nanofibers using the roller-electrospinning technique. The copper-based nanofibers undergo subsequent calcination and hydrogen reduction processes, resulting in the formation of nanofibers with varying oxidation states. A range of analytical techniques were employed to characterize the copper-based nanofibers. Scanning electron microscopy (SEM) was used to observe the nanofibers' surface morphology, while X-ray diffraction (XRD) provided insights into their oxidation states. Linear sweep voltammetry (LSV) was utilized to assess their electrochemical activity, and cyclic voltammetry (CV) examined the stability and reaction characteristics during the electrocatalytic process. Gas chromatography (GC) analyzed gaseous products, and high-performance liquid chromatography (HPLC) was used to identify liquid products formed during the electrocatalytic reduction of CO_2. The electrocatalytic reduction of CO_2 was carried out in a $KHCO_3$ solution using copper-based nanofibers as the working electrode, an Ag/AgCl electrode as the reference, and a platinum wire as the counter electrode. The copper-based nanofiber catalyst facilitated the conversion of CO_2 into carbon-containing products such as CO, CH_4, and C_2H_4. Faradaic efficiency was calculated based on the results of the electrocatalytic reaction.

Abstract No. 0142 Fu-Chi Teng

The continuous consumption of fossil fuels and the rapid increase in carbon dioxide (CO_2) emissions have caused critical environmental challenges, severely impacting the global climate and ecological balance. Converting CO_2 into high-value-added products offers a promising solution to reduce its concentration and emission. Among various CO_2 conversion technologies, the CO_2 reduction reaction (CO_2RR) has gained significant attention for its ability to covert CO_2 into valuable products under mild conditions. It offers several advantages, including high energy efficiency, tunable reaction rates, and enhanced product selectivity, making it a compelling approach for sustainable CO_2 utilization. However, the large-scale application of CO_2RR faces challenges due to the thermodynamic stability of the C=O bond in CO_2 molecules and the competing hydrogen evolution reaction (HER), which limits the efficiency and selectivity of CO_2RR. Therefore, the development of efficient, stable, and selective catalysts is crucial to overcome these limitations and advance CO_2RR technologies for practical and industrial-scale applications. Copper oxides, such as CuO and Cu_2O, have emerged as promising candidates for CO_2RR catalysts due to their high catalytic activity, low cost, and environmental friendliness. While extensive research has been conducted on the use of Cu_2O for CO_2RR[1], the catalytic behavior and underlying mechanisms of CuO as a catalyst remain unclear. Moreover, CuO exhibits superior thermal stability and corrosion resistance, making it suitable for long-term applications. In this study, we aim to comprehensively investigate the electrocatalytic properties of CuO(111) for the reduction of CO_2 into value-added C1 products, such as formic acid and formaldehyde using density functional theory calculations. We also examine the HER as a significant competing process in redox reactions, which is crucial for assessing the catalytic efficiency and selectivity of CuO for CO_2RR. Our findings will provide valuable insights into the catalytic mechanisms of CuO, contributing to the development of more effective catalysts for CO_2 utilization.

Abstract No. 0143 Tso-Fu Mark Chang

Organic dyes used in denim industry are persistent organic pollutants (POPs) that persist in the environment because of the long half-life, and this often leads to biomagnification in a food chain. Examples of the organic dyes are methylene blue (MB), rhodamine B, (RhB), malachite green (MG) and indigo. These organic dyes are toxic to humans and have been reported to pose a potential risk of causing cancer. Therefore, there is a growing interest in researching methods for the removal of these organic dyes from the environment, particularly from water sources.

Photocatalysts have emerged as a promising solution for removing organic dyes from wastewater by generating highly active radicals that can decompose the dyes [1]. The final products are simply CO_2 and H_2O. $BiFeO_3$ (BFO), $ZnFe_2O_4$ (ZFO) and $NiFe_2O_4$ (NFO) are mutiferroic materials possess multiple band gaps that enable them to absorb light in the visible and near-infrared regions, thereby generating the active radicals needed for photodegradation. Additionally, these materials exhibit decent magnetic properties, which allow for easy recovery from the treated solution using a magnet, thus preventing secondary pollution.

In this presentation, photodegradation of solutions containing MB, RhB, MG or indigo by these mutiferroic ferrite-based photocatalysts will be reported.

Abstract No. 0144 **Ju wen Chang**

In recent years, nations have strived to develop high-energy-density lithium batteries to meet the expanding electric vehicle market. The cathode material of lithium-ion batteries is a key factor determining battery performance. When selecting cathode materials, it is essential to consider cost, safety, performance, and environmental impact.Functional polymer cathode technology modifies cathode materials through slurry mixing or spray drying, forming a multifunctional composite film on the surface. This improves the stability of the electrode material and forms a dense SEI layer, reducing excessive reactions between the electrolyte and electrode, and preventing metal dissolution and other side reactions, thereby enhancing the battery lifespan and performance.The study introduce multifunctional polymer molecules into high-nickel ternary cathode materials via slurry mixing to fabricate electrode and battery. Their cycle life and battery aging mechanisms were analyzed. Results show this technology promotes uniform SEI layer formation during cycling, improves electrode structure stability, and achieves an initial battery specific capacity of over 210 mAh/g, with a 20-30% increase in cycle life compared to untreated samples. This technology has the potential to enhance the stability of current materials and extend cycle life, meeting growing market demand in the electric vehicle and energy storage.

Abstract No. 0146 **Zhong-Lun Li**

The depletion of fossil fuel resources has significantly driven research into alternative energy storage systems, particularly batteries and fuel cells. Rechargeable lithium-ion (Li-ion) batteries are currently regarded as a highly promising energy source for a wide range of portable electronic devices. However, with the surging global demand for large-scale applications such as electric vehicles, there is a growing interest in exploring alternative battery systems based on other monovalent cations like sodium (Na+) and divalent cations like magnesium (Mg2+). Mg-ion batteries are particularly appealing for the next generation of energy storage due to their low-cost, high-energy density, and enhanced safety. However, the diffusion of Mg2+ ions within hosts, such as the solid electrolyte interphase (SEI) layer and electrolytes, presents a significant challenge due to the strong ionic interactions between Mg2+ ions and the host lattices. Despite their potential, the slow kinetics of Mg-ions diffusion on the anode are not well covered in the literature. In this study, we considered various SEI layer compositions consisting of magnesium halides such as MgF2, MgCl2, MgBr2, and MgI2, with their layer and rutile structures, and explored Mg-ion diffusion within these structures using density functional theory (DFT) and climbing image nudged elastic band (CI-NEB) methods. The results show that the Mg- ion diffusion barrier in magnesium halide first decreases and then increases as the anion radius increases. Our study shows that the diffusion barrier in the layer structure is lower than that in the rutile structure. In addition, we used constant electrode potential (CEP) to study the conductivity of MgFBr covering the Mg anode to simulate charge and discharge. When an external voltage is applied, the structural difference is not significant but the conductivity is easily affected by the external voltage, indicating that the diffusion barrier can be further reduced during charge and discharge. This study provides design strategies for electrolyte components and suggests that modifying the crystal phase could improve magnesium-ion battery performance.

Abstract No. 0147 Daniel Chua

Electrocatalysts today have progressed to a stage which are much more complicated than simply noble metals. For example, a new generation of chalcogenides have been shown to be highly effective in the area of water splitting, especially hydrogen reduction reaction. Coupling these electrocatalyst are the carbon materials support which due to the ability to form different types of carbon allotrope, gives rise to a wide range of catalyst support having low dimensional effects and other unique physical properties.

We shall like to report on our work on the quest to find new effective electrocatalyst to further complement the existing noble metals (platinum) and low dimensional metal chalcogenides. We will show that beyond metal chalcogenides, various forms of metal phosphides and metal oxides can be engineered to obtain pre-determined structures and morphologies, which ultimately increase the effectiveness of water electrolysis. We will also show that some of these metal chalcogenides have other potential applications beyond water splitting, such as thermal vaporisers, photoelectrochemical cells and thermoelectric devices.

Abstract No. 0148 Denny H. Kuo

Fuel cells are an efficient and low-pollution energy system that converts chemical energy into electrical energy, with hydrogen as a common fuel. However, challenges in hydrogen storage and transportation limit its applications. In contrast, ammonia (NH3) offers advantages as a chemical hydrogen storage medium, and the possibility of ammonia fuel cells is gaining attention. Building on our former success in developing medium-temperature ammonia fuel cells, this study seeks to develop low-temperature ammonia fuel cells. Protonic ceramic fuel cells (PCFCs) display lower activation energy for proton diffusion, while solid acid fuel cells (SAFCs) increase conductivity after phase change, indicating strong potential for medium and low temperature applications. We built two types of fuel cells and used mass spectrometry to evaluate the ammonia decomposition performance of different catalysts, finally selecting the best catalyst for the anode. Through electrochemical testing, we further explored the probability of medium and low temperature ammonia fuel cells.

Abstract No. 0149 **Sooyong Choi**

To address the drawbacks of conventional anisotropic conductive films in flexible electronics, this study explored a novel flexible interconnection system comprising a flexible polyimide (PI) film with uniformly distributed Cu-filled holes. Periodic holes were formed along the PI film thickness. The holes were filled with Cu via electroplating, and both sides of the Cu ends were covered with Sn through electroless plating to form solder bumps. The resulting Sn-coated Cu vias exhibited low electrical resistance (22 mΩ) and high shear bonding strength (63.76 MPa). Nonconductive adhesive layers were applied on both sides of the films. Consequently, the interconnected chips exhibited a high shear bonding strength (85.55 MPa) and electrical conductivity (22 mΩ), maintaining 98.84 % and 100 % of the initial values respectively, even after 1,000 cycles of bending and ambient stability test at 85 °C. Light-emitting diodes integrated with a flexible printed circuit board using the proposed system demonstrated uninterrupted brightness, even under bending. To reduce the bonding temperature, Sn bumps are replaced with eutectic Sn/Bi. This is achieved by sequential electroplating of Bi and Sn onto the Cu head, followed by post-annealing to form a eutectic Sn/Bi alloy. The bonding mechanism and properties of electroplated Sn/Bi-coated Cu-filled PI films are compared with those of screen-printed Sn/Bi bumps and electroless-plated Sn bumps.

Abstract No. 0150 **Shih-Hao Yang**

This study presents the development and characterization of a carbonized ZIF-8 material loaded with gold nanoparticles (CZIF-8@Au) as the basis to construct a novel non-enzymatic electrochemical sensing for H2O2 detection. The CZIF-8@Au materials were characterized using scanning electron microscopy (SEM), X-Ray diffraction (XRD) and transmission electron microscopy (TEM) to confirm their chemical and structural characterization. To achieve the CZIF-8@Au uniformly modified working electrode, the CZIF-8@Au ink was obtained by dispersing CZIF-8@Au in a Nafion solution to form a stable homogenous CZIF-8@Au dispersion and further modified through drop-coating CZIF-8@Au onto a glassy carbon electrode (GCE) to fabricate the CZIF-8@Au modified electrode. The unique ZIF-8-derived nanoporous carbon structure provided a stable support for the growth of gold nanoparticles, offering effective active sites for electrocatalyzing H2O2. The CZIF-8@Au modified electrode exhibit excellent linear detection range, detection limit, and high sensitivity, highlighting its potential for future applications in sensitive H2O2 detection.

Abstract No. 0151 Chun-Wei Huang

This study utilizes one-step and two-step electrodeposition methods to synthesize bismuth-tin bimetal (BiSn), bismuth-tin bimetal-reduced graphene oxide (BiSn-rGO), and bismuth-tin bimetal/copper-reduced graphene oxide (BiSn/Cu-rGO) catalysts on copper substrates for their application in the electrochemical reduction of carbon dioxide (CO2) to formate (HCOOH). X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS) and Raman spectroscopy were employed to analyze the chemical characterization of materials. Field emission scanning electron microscopy (FE-SEM) and transmission electron microscopy (TEM) were used to characterize the surface morphology of materials. Linear sweep voltammetry (LSV), chronoamperometry, electrochemical impedance spectroscopy (EIS), and cyclic voltammetry (CV) were conducted to evaluate their electrochemical reduction of CO2 conversion to HCOOH in both H-type and electrolytic cells. The BiSn0.5-200 catalyst, prepared via one-step electrodeposition, achieves a maximum formate Faradaic efficiency of 84.5% at -1.8 V with a current density of 7.2 mA/cm². Meanwhile, the BiSn0.5/Cu-rGO-60 catalyst, prepared through two-step electrodeposition, attains a maximum formate Faradaic efficiency of 82.1% at -1.7 V with a current density of 7.47 mA/cm². Both catalyst electrodes demonstrate a lifespan of approximately 12 hours. These findings demonstrate the effectiveness of the two catalysts in the electrochemical reduction of CO2 and highlight the potential of electrochemical methods in catalyst preparation and CO2 reduction. In the future, these processes can be coupled with green electricity provided by the green power grid as a power source to achieve a sustainable and environmentally friendly cycle

Abstract No. 0152 Yung-Hsi Hsu

Electrochemically converting CO2 into valuable multi-carbon products is considered a promising strategy for reusing the notorious CO2 that induces severe global warming and climate change, realizing carbon cycling. Copper is the only catalyst known to produce multi-carbon products, such as ethylene, in the electrochemical CO2 reduction reaction (CO2RR). However, achieving high selectivity for these products at high current densities remains challenging due to the insufficient coverage of crucial intermediates. To address this issue and better regulate these intermediates, we designed a hollow multi-shelled cuprous oxide catalyst with multiple confined spaces between the shells. This design effectively manages the critical intermediate *CO and C2 intermediates within the different shells. X-ray absorption spectroscopy confirmed the valence state of the multi-shell copper to be approximately +1. Further analysis through resonant inelastic X-ray scattering and X-ray emission spectroscopy revealed that the multi-shell cuprous oxide exhibits distinct 3d orbital characteristics compared to commercial cuprous oxide, highlighting the impact of its unique multi-shell nanostructure on valence properties and the catalytic activity. Our hollow multi-shelled cuprous oxide catalyst achieved a Faradaic efficiency of 46.63% toward ethylene at a current density of 800 mA/cm2, with a partial current density of 373.04 mA/cm2, meeting the industrial criteria of 300 mA/cm2. We hope that our findings contributes to the global efforts to achieve net-zero emissions by 2050.

Abstract No. 0153 Yu-Chia Chang

Electrochemical reduction of carbon dioxide (CO2RR) presents a viable approach to reduce atmospheric CO2 while converting it into economically valuable products such as ethylene and ethanol. Among various catalysts, copper-based catalysts uniquely enable the conversion of CO2 into multi-carbon products. However, achieving ampere-level activity remains challenging due to insufficient coverage of crucial intermediates, such as CO*, on the copper surface, thereby limiting the industrial development of CO2RR. To address this challenge, in this study, we synthesized CuO nanotubes (CuO NTs) that concentrate these essential intermediates within confined tubes. Additionally, we modified the copper surface with hydrophobic molecules to enhance gaseous CO2 transport to the catalyst surface. These advancements enabled our catalyst to achieve a Faradaic efficiency of 60.59% for C2 products at a current density of 1 A/cm^2, with a partial current density of 605.9 mA/cm^2. In-situ X-ray absorption spectroscopy revealed that the copper oxide nanotubes rapidly reduced to a metallic state during CO2RR, further improving charge transportation for electrocatalysis. The innovative design of our catalyst supports ampere-level CO2RR performance. We believe our approach offers promising strategies to accelerate industrial CO2RR and contribute to achieving Net Zero Emissions.

Abstract No. 0154 Cheng-Chung Chen(陳正忠)

The TiO2 nanotube arrays were synthesized by electrochemical anodization, and subsequently the crystalline phase transformation of TiO2 nanotube arrays could be controlled during the annealing process from room temperature (RT) to 800oC. The TiO2 nanotube arrays serves as a well-optimized special architecture for efficient photoelectrochemical performance. The physical and chemical properties of TiO2 nanotube arrays were conducted using by field emission scanning electron microscopy (FESEM), transmission electron microscopy (TEM), Raman spectrometer, X-ray photoelectron spectroscopy (XPS), and high-resolution X-ray techniques with synchrotron source (including Small/Wide-Angle X-ray Scattering (SWAXS). Electrochemical analytical methods were used to evaluate the photochemical performance of TiO2 nanotube arrays under visible light irradiation turning on and off. The results presented in this work point out that TiO2 nanotube arrays exists in three different crystalline phases (including anatase, rutile, and brookite) depended strongly on the annealing temperature, having a significant influencing on photoelectrochemical performance. The findings will encourage and assist our group in further efforts to investigate the effect of annealing temperature on the crystalline phases of the TiO2 nanotube arrays, providing valuable insights for the design and application of future photoelectrochemical devices.

Abstract No. 0155 **Hsing-Kai Tseng**

The intensification of global warming has underscored the importance of secondary ion batteries with charge and discharge capabilities in achieving carbon reduction and net-zero emission goals. Currently, lithium-ion batteries (Li-ion batteries, LIB) are the dominant technology. However, due to the scarcity of lithium resources and supply risks, as well as the toxicity and flammability of its organic electrolytes, researchers are developing alternative battery systems. Aqueous electrolytes, with their advantages of low cost, high safety, and environmental benefits, particularly aqueous zinc-ion batteries (aqueous zinc-ion battery, AZIB), have shown significant development potential. Zinc's low reduction potential, high volumetric capacity, and low cost have attracted global corporate investment, making AZIBs a highly feasible option for commercial secondary batteries. Successful commercialization would lead to substantial demand for AZIB materials. Additionally, since vanadium, a critical material, is used in AZIB cathodes, the development of recovery technologies is essential. To reduce environmental impact and align with circular economy principles, this study employs hydrometallurgical techniques to recover vanadium metal from the cathodes of waste aqueous zinc-ion batteries. The processes involved include leaching, solvent extraction, chemical precipitation, and calcination. The regenerated product is a stable, high-purity metal oxide that is easy to store and can be directly used in industrial processes. This approach not only addresses the disposal challenges of spent AZIBs but also enables resource recycling, aligning with the circular economy principles and supporting the Sustainable Development Goal (SDG) of ensuring sustainable consumption and production patterns. Through this method, we can reduce environmental pollution while transforming waste into valuable resources, driving society toward a more sustainable and eco-friendly future.

Abstract No. 0156 **Hung-Yu Lai**

In this study, a mixed solution of (NH4)2TiF6 and H3BO3 was used, and liquid phase deposition (LPD) was used to deposit LPD-TiO2 thin films on graphite felt (GF), and then soaked in urea and annealed in an atmospheric environment to dope nitrogen into the LPD-TiO2 film for application in the negative electrode of an all-vanadium redox flow battery (VRFB). Research results show that compared with LPD-TiO2 without nitrogen doping, nitrogen-doped LPD-TiO2 can significantly improve the V2+/V3+ redox reaction and show better electrochemical activity. The negative electrode applied to VRFB can reduce polarization phenomena and effectively improve coulomb efficiency (CE), voltage efficiency (VE) and energy efficiency (EE).

Abstract No. 0157 **CHANG, HSIEN SHUN**

With the rapid advancement of digital devices and electric vehicles, high energy-density rechargeable batteries are strongly required. Among the various anode materials, lithium metal has emerged as a highly promising anode material due to its ultrahigh specific capacity and extremely low electrode potential, making it ideal for next-generation lithium metal batteries (LMBs). However, significant safety concerns arise from the risk of short circuits caused by severe dendrite growth, which can lead to explosions or fires due to the flammability of liquid electrolytes. While high-concentration electrolytes (HCEs) present a promising way to stabilize the lithium metal anode, their high viscosity and poor wettability impede good Li-ion diffusion kinetics. Recently, localized high-concentration electrolytes (LHCEs) have been proposed to address these limitations by incorporating diluent solvents. Despite these advantages, challenges remain, including unresolved fire hazards and unclear solid electrolyte interphase (SEI) formation with diluted electrolytes, which impede the practical application of LHCEs. This study aims to develop multifunctional LHCEs to stabilize the SEI, suppress dendrite formation, and enhance the safety of LMBs. We constructed six distinct electrolyte systems using a combination of ether and carbonate solvents, Lithium bis(fluorosulfonyl)amide (LiFSI), and Lithium hexafluorophosphate (LiPF6), with 1,1,2,2-tetrafluoroethylene 2,2,3,3-tetrafluoropropyl ether (TTE) as the diluent. The compositions of these electrolyte systems are summarized in Table 1. The interfacial phenomena at the lithium metal anode surface are investigated using density functional theory (DFT) with ab initio molecular dynamics (AIMD) simulations. Our results indicate that ether-based electrolyte solvents exhibit a lower LUMO compared to carbonate-based electrolytes, effectively suppressing solvent decomposition at the lithium anode and enhancing SEI stability.

Abstract No. 0158 **Ching-Hao Liu**

This study investigates a noninvasive sensor for detecting glucose concentrations in saliva, addressing the increasing prevalence of diabetes and the discomfort associated with needle-based measurements. By enhancing measurement convenience, we aim to improve patient compliance in glucose monitoring. Our research integrates nanopolymers and glucose oxidase onto carbon paper electrodes to fabricate the sensor, focusing on increasing sensitivity and stability while eliminating measurement-related inconveniences.

Polypyrrole is deposited on carbon paper substrates through electro-polymerization, followed by enzyme adsorption using polyethylene imine (PEI). We employ electrochemical systems to evaluate electron transfer efficiency and glucose concentrations, utilizing various analytical instruments to assess the surface properties and microstructure of the electrodes. This comprehensive approach facilitates the exploration of correlations among material analysis, electrochemical performance, and sensing results. The findings indicate that the oriented conductive polymer enhances catalytic activity, increases surface area, and reduces charge transfer resistance. Consequently, the electrode achieves a sensitivity of 222.25 μA/mMcm2 within a linear range of 20 to 700 μM glucose, demonstrating the biosensor's potential for monitoring glucose levels in saliva.

Abstract No. 0159 Lei Hu

The research utilized molybdenum diselenide ($MoSe_2$) as one of the components for constructing electrochemical electrodes. $MoSe_2$'s pseudocapacitive characteristics improved the sensitivity of these electrodes. To enhance measurement sensitivity even further, $MoSe_2$ was integrated with carbon nanotubes (CNTs) arranged in a hive pattern. This hive configuration was created using photolithography, which significantly increased the interface area between the electrode and the electrolyte, thereby boosting the electrode's sensitivity. For practical applications, cholesterol oxidase (ChOx) was applied to the surface of the electrode. The electrochemical interaction between ChOx and cholesterol results in the formation of hydrogen peroxide (H_2O_2), which allows the determination of cholesterol levels based on the quantity of H_2O_2 produced. In this research, a sensitivity of 24.3 uA/mM·cm2 was observed in the H_2O_2 concentration range from 1 mM to 10 mM, as shown in Fig. 1. The better sensitivity and the linear response indicate that the ChOx/$MoSe_2$/CNTs configuration functions effectively as an electrochemical sensor.

Abstract No. 0160 Ching-Hao Liu

Diabetes is a prevalent global chronic disease and a leading cause of death, often associated with modern lifestyles. Conventional invasive methods for blood glucose detection can discourage patient compliance. This study focuses on the development of a non-invasive sensor for detecting glucose in saliva by exploring the modification of sensing electrodes with specialized materials to significantly improve sensitivity. In this study, we employ a unique approach that uses carbon nanotubes on a carbon paper substrate to serve as both a crosslinker and structural support through the drop-casting technique. Subsequently, we directly grow polypyrrole on the carbon nanotube, resulting in a hydrogel formed via electrostatic interactions between these two materials. The final step involves depositing glucose oxidase onto the polypyrrole hydrogel. Notably, carbon nanotubes serve as crosslinkers, effectively binding the polypyrrole chains to form the hydrogel. This hydrogel possesses flexibility, a substantial surface area, a 3D interconnect structure, and significant porosity, all of which facilitate electron and ion transport, ultimately enhancing electrode sensitivity.

Detailed material and electrochemical analyses reveal that the electrode structure designed in this study possesses an extensive active surface area, optimal electron transport efficiency, and significant enzyme adsorption capacity. The electrode shows high sensitivity of 119.74 μA/mMcm2 in the linear range of 50 to 700 μM with an R^2 value of 0.9868. In artificial saliva, the electrode demonstrates a sensitivity of 104.88 μA/mMcm2, an R^2 value of 0.9942, and a linear range of 100 to 700 μM. Furthermore, the electrode demonstrates remarkable stability and exceptional selectivity for glucose detection. These results demonstrate the electrode's remarkable sensing capabilities and its practical applicability for salivary glucose detection.

Abstract No. 0161 Xinyu Jin

Persistent organic pollutants (POPs) are organic chemicals that persist in the environment for an extended period due to their long half-life. As a result, there is a continuous research focus on removing POPs from the environment. Photocatalysts hold promise for removing POPs from water-based solutions by producing highly active radicals capable of breaking down the pollutants. $NiFe_2O_4$ (NFO) is a promising visible light driven photocatalyst, and its ferromagnetic property enables easy retrieval of the NFO particles dispersed in a water-based solution using a magnet. Malachite green (MG) is a common organic dye and serves as an example of a POP. The prepared NFO has been confirmed to have a cubic spinel structure after being heated to a temperature above 400°C, as shown in the X-ray diffraction (XRD) pattern in Figure 1 (a). The photodegradation efficiency of NFO with different heat treatments is depicted in Figure 1 (b), while the effects of sonication are illustrated in Figure 1 (c).

Abstract No. 0162 Ding Huei, Tsai

Electrocatalysis carbon dioxide reduction reaction (ECO2RR) is high potential solution for tackling the climate change and detrimental effect of CO_2 emissions in atmosphere. ECO2RR is a feasible way to realize carbon-neutral energy cycle for the ultimate goal of carbon net-zero emissions in 2050. In this work, we tried to tackle the problem of CO2RR activated catalyst, including the shorten of electrochemical surface area (ECSA) and the weak creation of triple-phase boundary, both of which are directly connect to the CO2RR performance. we suggested a novel strategy for catalyst design, the soluble material magnesium oxide (MgO) and magnesium hydroxide ($Mg(OH)_2$) incorporated with the metal catalyst copper (Cu). The MgO/$Mg(OH)_2$ played the carrier role in the synthesis step initially, then changed the character as the sacrificial agent when electrochemical testing. The non-electrochemical dissolution of MgO/$Mg(OH)_2$ happened when contacting with the CO_2 (g) and H_2O (l) spontaneously, prompting the raw CuO-MgO/$Mg(OH)_2$ turned into the high surface area copper (HSA-Cu). We provide three type of synthesis method including impregnation (Im-HSA-Cu), co-precipitation (Co-HSA-Cu) and chemical reduction (Cr-HSA-Cu) to discuss the relation between the morphology of cathode catalyst layer and ECO2RR performance. As our report mentioned, the Co-HSA-Cu can provide the highest ECSA= 12.2 m^2/gm above all catalyst tested, which is 5-fold of commercial copper oxide nanoparticle (Nano CuO). The following electrochemical testing showed that all of the HSA-Cu were better than commercial Nano CuO, double prove the high ECSA advantages. Continuously, the zero-gap MEA system had the several optimized. To avoid the severe flooding issues, the potassium bicarbonate catholyte were replaced by diluted potassium hydroxide. The area counter electrode enlargement could benefit the system. Finally, we reached the j_{CO2RR}= 101.3 mA/cm^2 and j_{C2H4}= 76.0 mA/cm^2 at 3.4 V and Faradaic efficiency FE_{C2H4}= 29.3 % at 3.2 V for C_2H_4 product, a four-fold improvement compare with the commercial catalysis.

Abstract No. 0163 陳彥瑋

Green hydrogen is typically produced through water electrolysis. Alkaline water electrolysis has been the focus of many studies due to its use of non-precious metal electrocatalysts. Polyurethane sponge (PUS) is widely used in leftover materials and product scraps from home appliances and furniture, producing significant waste. This waste poses a challenge for ecological degradation; therefore, recycling polyurethane foam waste is essential. The study used a polyurethane sponge (PUS) mixed with metal precursors such as Fe, Cu, and Mo. This mixture prepared an electrocatalyst based on the PUS structure and included NH- -functional groups. The N in NH- groups on PUS possess lone-pair electrons that can react with metal ions through chelation, forming electrocatalysts in metal-N structures. As illustrated in Figs, the metal-N can enhance the efficiency of the hydrogen evolution reaction (HER) and oxygen evolution reaction (OER). 1(a) and (b). The study found that heating the materials to 200°C and 300°C resulted in the best HER and OER performance in alkaline water electrolysis for FeCuMoOx-PUS

Abstract No. 0164 Ulya Qonita

Li-CO2 batteries with a discharge potential of ~2.8V and an enormous theoretical energy density of ~1847 Wh·Kg-1 are one of the best candidates to solve the CO2 emissions issues by utilizing them as an energy storage device. However, the Li2CO3 formed during the discharge process often causes a large overpotential during charging which reduces energy efficiency. This shortcoming can be solved by using a catalyst on the cathode or in the electrolyte. Tetraethylene glycol dimethyl ether (TEGDME or Tetraglyme) is a widely used electrolyte solvent for Li-CO2 batteries. In this study, we observed that in the presence of high purity CO2 (4N), the lithium metal immersed in an electrolyte (1M LiTFSI in Tetraglyme) spontaneously corroded without any electromotive force applied. The surface of lithium metal was darkened after CO2 gas was purged into the Argon-sealed reactor. After 48 hours of purging, the lithium metal completely turned white which based on the FTIR result corresponds to the Li2CO3 [1-3]. We also observed a chemical shift of 1H-NMR at δ peak of 3.4 ppm, 19F-NMR at δ peak of -78.75 ppm, and 7Li-NMR at δ peak of 1.04 ppm of the electrolyte after CO2 is purged [4, 5]. We postulated that this chemical shift of the above-mentioned NMR spectra is related to lithium ionization. Thus, the ionized lithium reacts with CO2 to form Li2CO3 with a prolonged immersing time; in which Tetraglyme acts as a mediator in this reaction. Our solution for this issue is an application of organic coverage (OC) based on a functionalized oligomer on the carbon electrode. After the coverage, a larger discharge capacity (41477 mAh·g-1) of the OC-modified carbon compared to the pristine carbon (33400 mAh·g-1) in the Li-CO2 battery was observed. This indicates the higher adsorption of CO2 on the cathode side. Thus, this mechanism prevents the CO2 dissolution in the electrolyte. As a result, lithium corrosion is mitigated.

Abstract No. 0165 Shun-Feng Kuan

Iron oxide (Fe2O3) with a high theoretical capacitance, wide potential ranges and easy availability has attracted much attentions as the electrode material of battery supercapacitor hybrids (BSH). Metal–organic framework (MOF) is one of the promising potential energy storage materials due to its large surface area and controllable pore structures. In this work, novel iron oxide/iron organic framework composites (Fe2O3/FeMOF) are in-situ grown on the Ni foam as efficient energy storage electrodes of BSH. By tuning the solvothermal durations, the morphology changes from random sizes of sheets, regular grown vertical sheets, to flower-like structures. The d-spacing also increases for the Fe2O3/FeMOF synthesized using longer solvothermal durations. The optimal Fe2O3/FeMOF electrode synthesized using 9 hours shows a high areal capacitance of 10.97 F/cm2 along with an areal capacity of 5.49 F/cm2 at the current density of 35 mA/cm2, owing to the most regular growth of sheets, the large d-spacing, and the smallest charge-transfer resistances. A BSH composed of the Fe2O3/FeMOF positive electrode and a graphene negative electrode shows a maximum energy density of 0.76 mWh/cm2 at 22.5 mW/cm2. The excellent long-term cycling stability with the capacitance retention of 85% and Coulombic efficiency of 98% are also achieved after 10000 charge/discharge cycles.

Abstract No. 0166 Ching-Tzu Liu

his work presents a novel water-based conductive ink based on the simple and inexpensive fabrication of handmade carbon-printed electrodes obtained by adequately combining carboxymethyl cellulose (CMC) and multiwall carbon nanotubes (MWCNTs). The ink is then used to screen-print electrodes on polyethylene terephthalate (PET) plastic. Fig 1 shows the process of making ink and screen printing a chip. The purpose of the electrode modification in this study is to offer another perspective for developing electrochemical biosensors, particularly for detecting ovarian cancer using CA-125 biomarkers. Our work provides portability, low cost, and quick response, promising solutions to current challenges. This research has the chance to inspire continued exploration of innovation and environmentally friendly platforms for biosensor applications.

Abstract No. 0167 Shih-Che Lin

Aqueous zinc-ion electrolytes are highly safe, and zinc resources are abundant. However, current aqueous zinc-ion electrolytes are often accompanied by parasitic water reactions, leading to side reactions. To address this issue, we propose a strategy of adding adenosine as an additive to zinc sulfate aqueous solutions. Adenosine helps guide the deposition of zinc metal ions and replaces some of the water molecules coordinating with zinc, thereby reducing water side reactions and improving the cycling life.[1]

The results show that in deposition/stripping tests using a three-electrode cell, the overpotential of the deposition branch increases with increasing adenosine concentration, confirming the effect of adenosine on zinc deposition. In in-situ OM tests, it was observed that compared to the electrolyte without adenosine, the electrolyte with adenosine forms fewer zinc dendrites after deposition, and most of the zinc can be stripped from the copper foil during the subsequent stripping step, leaving less residual zinc metal on the electrode after cycling. In contrast, the electrolyte without adenosine leaves significantly more zinc metal on the copper foil after cycling, which can eventually lead to battery failure over time. X-ray analysis reveals that the zinc metal particles deposited on the copper foil in the electrolyte with adenosine are smaller, and these smaller zinc particles can stack more densely and uniformly during the deposition process, which enhances the overall battery performance.

In summary, the presence of adenosine affects zinc deposition behavior, thus improving plating/stripping efficiency and enhancing battery performance.

Abstract No. 0168 Huang Chen En

In recent year, lithium-ion batteries have been the most utilized materials for energy storage. However, due to the high price and uneven distribution of the lithium element on earth, the new battery candidate, sodium-ion battery (SIB) is getting more and more attention. The most valuable research in the varying SIB materials is the SIB cathode material. Within the diverse research of proper candidates for future cathode materials, Na3V2(PO4)2F3 stands out. Due to its high theoretical capacity (128 mAh/g), high theoretical energy density (507 Wh/kg), and high voltage performance (avg. 3.9 V), Na3V2(PO4)2F3 (NVPF) is highly recommended for future SIB cathode material.

In this research, we use citric acid as a chelating agent and carbon source to optimize the performance of the NVPF cathode in SIB half cells. The synthesis method is through the spray dry method, which is highly beneficial for large manufacturing and commercial uses. Different moles of citric acid to Vanadium were tested in this research (ratio of V : citric acid = 1 : 0.4/0.6/0.8/1.0/1.5/2.0). Battery rate performances and different rate long cycle performances of different amounts of citric acid were tested. We found out the best ratio of citric acid to Vanadium is 0.8 mole to 1 mole, which achieves the high capacity (121 mAh/g, 0.1C/119 mAh/g, 1C) in the rate performance test.

XRD was performed to prove the crystallization of NVPF. TGA was operated to analyze the carbon content of different citric acid ratio in NVPF samples. EIS was performed to show the impedance. CV curve and GCD curve are also shown in this research. Finally the SEM, EDX, and ICP were also shown to verify ratio of elements in NVPF.

Abstract No. 0169 Yu-Hsuan Chen

Recently, layered oxides developed by a single-crystal process has received great attention. Ni-rich layered oxides with m-size grain size tend to give better cycling performance with enhanced structural integrity and less volume change during extended cycling tests. Single-crystal process, in fact, involves heating/calcination of oxide/carbonates/nitrates powder compacts. As a result, factors such as temperature, annealing period and atmospheres may be critical for high-performance cathode. Thus, the objective of this study is to determine the effect of lithium salt content in the precursor on the formation of single-crystal NCM811 and to optimize key factors to achieve better performance. For factor verification and understanding of single crystal process, the resulted electrical, structural, and electrochemical properties of layered oxides will be analyzed and discussed based on defect chemistry consideration. During the different stages of processing, the structural, microstructural and electrical properties of decomposed precursors and resultant layered oxides will be examined using XRD, SEM and DC/AC impedance measurements. CV and charge/discharge tests from assembled coin cells will be used to evaluate electrochemical properties of single-crystal Ni-rich layered oxides.

Abstract No. 0170 Cheng-Hung Liao

"Among many cathode materials, nickel-rich LiNi0.83Co0.12Mn0.05O2 (NCM 831205) has been spotlighted as one of the most feasible candidates for next-generation LIBs because of its high discharge capacity (~200 mAh/g). However, NCM 831205 shows significant performance degradation, which is mostly attributed to cation mixing, surface side reactions, and intrinsic structural instability originating from the large volume changes during repeated cycling.

Conventional lithium ion batteries (LIB) normally use flammable nonaqueous liquid electrolytes, resulting in a serious safety issue in use. In this respect, all solid state lithium ion batteries (SSLIBs) are regarded as a fundamental solution to address the safety issue by using a solid state electrolyte (SSE) in place of the conventional liquid one.

This study assess the performance of NCM 831205 cathode for all-solid-state batteries based on hybrid PEO-ceramic solid electrolyte. Artificial CEI coating layer has been developed in order to prevent direct contact of electrolyte with the cathode, thus avoid the negative effects, such as side reactions, on NCM 831205. The incorporation of ceramic materials results composite electrolytes, containing inert fillers, offer improved mechanical stability under high operating temperature.

It is demonstrated that the polymer of hybrid electrolytes can penetrate into cathode, providing a good protective layer inside the battery under high operating temperature. Moreover, this protective coating on NCM 831205 effectively improve the electrochemical stability."

Abstract No. 0171 Bo-Yang Chuang

Sodium resources are abundant and much cheaper than lithium, making sodium-ion batteries a cost-effective alternative to lithium-ion batteries. tin disulfide (SnS_2) is considered a potential anode material for sodium-ion batteries due to its high theoretical capacity. However, its poor electrical conductivity and significant volume changes during charge-discharge cycles.This study investigates the effects of different solvent ratios (deionized water and ethanol) on the crystallinity of SnS_2 (SnS_2-D and SnS_2-E, respectively) to enhance its performance. The results show that using ethanol improves the crystallinity of SnS_2, which helps maintain better structural stability during charge-discharge cycles. Additionally, a structure-directing agent, cetyltrimethylammonium bromide (CTAB), was employed to synthesize SnS_2-D/E (SnS_2+CTAB-D/E 2:3) to increase the specific surface area, enhance material stability, and expand the interlayer spacing. The study demonstrates that optimizing the amount of CTAB can effectively increase the interlayer spacing of SnS_2, The results indicate that the composite material with a solvent ratio of 2:3 (deionized water to ethanol) exhibits a specific capacity of 281 mAh/g at a current density of 1.6 A/g.

Abstract No. 0172 Masato Sone

Recently, MEMS accelerometers employing Au components prepared by electrodeposition are reported to have a small size whiling retaining a high sensitivity by Au's high mass density [1] and to realize the detections of body tremors and muscular sounds [2]. However, low mechanical strength of Au, when compared to Si-based materials used in conventional MEMS accelerometers, leads to insufficient structure stability for the long-term use of the device. To enhance the mechanical strength of Au-based materials, multi-layered metal technology has been reported [3].

Cantilever-like structures are commonly used in movable components in MEMS devices [1, 3]. Repeatedly electrodeposition of gold following by deposition of a material with a high mechanical strength to realize a multi-layered structure is an effective strategy to enhance the structural stability [4]. From the Euler-Bernoulli beam theory, the structural stability of a cantilever-like structure is improved by using materials having high Young's modulus (as noted E). Although, the E is an intrinsic property of materials, which should be constant as the specimen size changes, but the E of small-sized specimens is reported to differ as the size changes. The E of a small-sized specimen with a specific geometry is called the effective Young's modulus (Eeff). The Eeff of a micro-cantilever could be determined from the resonance frequency of the micro-cantilever, and the resonance frequency could be measured by a laser doppler vibrometer.

In this report, various Ti/Au multi-layered structures were prepared. Firstly, the Eeff of complex three dimensional (3D) multi-layered Ti/Au structures was determined from the resonance frequency obtained with a laser doppler vibrometer. Next, we studied the effects of these various Ti/Au multi-layered structures on the long-term structure stability by vibration tests. Lastly, we discuss the relationship between the Ti/Au multi-layered structures with characteristic Eeff values and long-term structure stability. The discussion could contribute to the material design for highly sensitive and stable MEMS accelerometers.

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Abstract No. 0173 Yu-Pei Chiang

With the rapid development of the electric vehicle industry, the demand for energy storage technologies has been increasing. However, lithium-ion batteries face developing challenges such as high material costs and recycling difficulties. In this context, lithium-sulfur batteries have emerged as a promising choice of development. Lithium-sulfur batteries not only benefit from abundant and low-cost sulfur resources but also possess a high theoretical energy capacity. Although there are many advantages of lithium-sulfur batteries, issues such as sulfur's insulating properties, polysulfide dissolution, and significant volume changes of lithium sulfide limit their electrochemical utilization and cycle life. To address these challenges, this experiment employs a electroless nickel-plating technique to form uniformly nickel coat the outer layer of sulfur, thereby enhancing its conductivity and chemical affinity for polysulfides. This treatment enables lithium-sulfur batteries to achieve stable cycling for up to 500 cycles at a charge/discharge rate of 2C. Specifically, we used a tape-casting technique to prepare mass-productionable high-performance cathode by mixing nickel/sulfur powder in a ratio of 70wt%, 15wt% conductive carbon powder, and 15wt% polymer binder. This cathode has a high sulfur loading of 8 mg cm^(-2) and an areal capacity of up to 5.6 mA h cm^(-2), demonstrating promising performance potential. These research findings provide a feasible technological pathway for the commercialization of lithium-sulfur batteries.

Abstract No. 0174 Jue-Hua Pan

As the demand for electricity grows violently, it is hard to rely only on the support of renewable energies, such as solar cells or wind power, which are unstable power supplies. In this way, raising energy conversion efficiency becomes a vital issue. In this study, we synthesized a novel high entropy material for energy conversion application. High-entropy materials are attracting ever-increasing concern for their unique structural features and unprecedented potential applications. Choosing adequate elements as dopants, we found out the crystal lattice distorted , and the energy barrier for charge carrier transporting changed. Under a wet hydrogen atmosphere, conductivity can reach good performance. Since the dopants are transition metals, the valence states of each element may change, leading to an interesting crystal environment. Each element has different kinds of contributions to electrochemical performance; some of them play the role of increasing conductivity, and some of them offer stabilization. Besides, under the high entropy effect, high entropy material shows good structure stability under a high-temperature environment and severe chemical ambiance. Seeing the above results, it is expected that high entropy oxides can be a promising candidate in energy conversion.

Abstract No. 0175 Ying-Chen Wu

As electricity demand increases, scientists are exploring new battery systems. Rechargeable magnesium (Mg) battery, with its high theoretical volumetric capacity, low cost, and environmental friendliness, has emerged as one of the candidates for beyond lithium (Li)-ion battery systems. More importantly, Mg metal anodes are less prone to dendritic growth during charging, which enhances the overall safety of the battery system. In recent years, anode-free battery systems have also been introduced to improve the battery capacity. However, most studies focus on developing new electrolytes, and the microstructure of the Mg metal anodes after cycles is not fully characterized. In this study, we compared the microstructure and electrochemical behavior of electrodeposited Mg after discharge/charge cycles on a pure Mg anode and a copper (Cu) current collector in an all phenyl complex (APC) electrolyte. From the potential evolutions of discharge/charge tests on the electrodeposited Mg, the discharge overpotentials rise at the end of the discharge stages after 4 cycles on the Cu current collector. This is due to the uneven discharge/charge behavior that leads to the exposure of the Cu substrate and the decrease in the electrodeposited Mg area, increasing the required overpotentials. Then, from the microstructure characterizations, the adhesion between the electrodeposited Mg and the Cu current collector was weaker than that between the electrodeposited Mg and the pure Mg anode, leading to possible delamination and chunk effect. Additionally, whether pure Mg or Cu was used as the anode substrate, the Mg grain size decreased with increasing cycles.

Abstract No. 0176 Yu-Hsuan Chiu

Prussian blue analogous (PBA) has the advantages of rich 3D diffusion channels, open nanoporous skeleton structure, large specific surface area and low cost has been widely used as a capacitor material for battery supercapacitor hybrids (BSH). In this study, precursor solutions with pH values of 1, 2 and 4 were prepared, and without adding nickel precursor, nickel foam was used to release nickel ions in acidic solution, using a one-step solution synthesis method at room temperature. Preparation of Ni-Co PBA on nickel foam. Ni-Co PBA (Ni-Co PBA/NF-2) prepared using pH2 has a maximum specific capacitance value (CF) of 2395 mF/cm2 at a scan speed of 20 mV/s, as shown in Figure 1. As shown in Figure 2, the maximum specific capacitance value (CF) was achieved at a current density of 20 mA/cm2, which was 1754 mF/cm2. Finally, in Figure 3, the BSH composed of Ni-Co PBA/NF-2 positive electrode and graphene negative electrode maintained a capacitance retention rate of and coulombic efficiency 97.2% after 6250 repeated charge and discharge cycles.

Abstract No. 0177 Arumugam SuryaPrakash

The redox flow battery is a cost-effective solution for grid-scale energy storage. Its special feature of separate reservoirs and electrodes makes it easy to adjust electrolyte volume and electrode size, improving safety and scalability. In this work, we explore two organic anolytes, chelidamic acid (CDA) and chelidonic acid (CDO), which share similar molecular weight but differ in their heteroatoms: pyridone and pyrone. The half-cell potentials of CDA and CDO anolytes enable them to exhibit theoretical cell voltages of 0.49 V and 0.48 V, respectively, when coupled with K_4 [⟦Fe⟧]^II (CN)_6] catholyte. CDA demonstrated a stable discharge capacity of 650 mAh/L over 17 days in a basic medium without any degradation. In contrast, CDO gradually loses its capacity over successive cycles. Additionally, CDA demonstrates stable cyclic performance over 230 cycles, significantly outperforming CDO at high current density of 40 mA/cm2, with an average coulombic efficiency of 98%. The mechanism for the decomposition of CDO was analysed through cyclic voltammetry, 1H-NMR, FTIR spectroscopy and DFT techniques. The analytical and theoretical results revealed that there was a significant impact of tautomerization in CDA and nucleophilic addition in CDO on the performance in ARFB.

Abstract No. 0178 鄧名傑

As the demand for low carbon emissions and sustainable energy grows, supercapacitors have emerged as a key electrochemical energy storage option [1,2]. This study addresses the flexibility and electrolyte leakage concerns of wearable devices by using flexible conductive carbon fiber cloth (CC) as the substrate and a novel ionic liquid-based Mg ion gel as the electrolyte. Polyaniline (PANI) is electrochemically polymerized on the CC to function as symmetric energy storage electrodes. The prepared PANI film has a nanorod structure, which enhances ion interaction between the electrode and electrolyte and improves the faradaic redox reactions. A Mg ion gel electrolyte, PALU-MgCl2, was used, and SEM, FTIR, and XPS were employed to analyze the surface morphology and chemical structure of the electrodes.

Experimental results demonstrated that PANI//PANI symmetric supercapacitor operates at a large voltage window of 2.0 V and provides excellent energy density (121.7 Wh/kg with a power density of 5000 W/kg) and specific capacity (219.1 F/g). At higher current densities of up to 10 A/g, it still maintained a specific capacitance of 152.5 F/g, showcasing efficient energy storage and excellent charge-discharge characteristics. Additionally, the device demonstrated good mechanical stability and long cycle life, with a 90% capacitance retention rate after 3000 cycles.

Abstract No. 0179 Ming-Si Jian

Recently, rechargeable aluminum (Al) batteries (RAB) have been studied [1] due to their excellent theoretical volumetric capacity (8,046 mAh cm-3) and sustainability. However, most RAB studies focused on developing electrolytes and compatible cathodes, while the microstructure of the metal anodes was overlooked. In this report, we studied the microstructure of electrodeposited Al on Al or copper (Cu) substrates at different current densities in an AlCl¬3/urea ionic liquid analog electrolyte. Through SEM characterizations, we found that the higher the current density, the more Al nucleation sites, and thus, the denser and smaller the deposit nodules. Meanwhile, the deposit nodules grow with the plating time. We also found that the nodule size of the electrodeposited Al on the Al substrate is larger than on the Cu substrate at the same current density. Furthermore, we observed the growth of leaf-like Al crystals on both substrates at small current densities with long plating times. This preferential growth of Al crystals perpendicular to the substrates may cause safety issues during charging in RAB applications.

Abstract No. 0180 Chai-Lung Hsieh

In the pursuit of high-power all-solid-state rechargeable batteries, achieving exceptional ionic conductivity in solid electrolytes has become a goal. The superionic argyrodite family, particularly exemplified by Li6PS5Br, has considerable potential to be developed.1, 2 Nonetheless, the full exploitation of their potential, encompassing heightened ionic conductivity, surface stability and air stability, remains a challenge to be surmounted.3, 4 Addressing these critical aspects, bromine-rich and dual-doping argyrodite electrolytes was developed by high-rotation milling and annealing. Through precise tuning of the Br and the Sb dopant concentration, adjusted composition Li6-xPS5-xBr1+x (0≦x≦0.8) and Li5.5P1-ySbyS4.5Br1.5 (0≦y≦0.6) to deliberate augmentation of Br-/S2- ion mixing, a significant leap forward in ionic conductivity.5 The ionic conductivities of Li5.5PS4.5Br1.5 and Li5.5P0.95Sb0.05S4.5Br1.5 at 25°C are both 4.5 mS·cm-1, and dual-doping shows better air stability than Li6PS5Br. The relationship between temperature-dependent variations in bromine/lithium composition and phase transitions was investigated through in-situ X-ray diffraction (XRD). Based on the data obtained from in-situ X-ray diffraction (XRD), the optimal annealing temperature can be determined, facilitating the subsequent synthesis of purer samples. Additionally, based on the critical current density data, it is evident that the dual-doped sample can withstand higher current densities and exhibit superior electrochemical performance during charge-discharge testing. The dual-doped samples also demonstrated excellent H_2S suppression capabilities in humidity tests, reducing production by 60% compared to Li6PS5Br. With promising ramifications for the future of all-solid-state Lithium metal batteries, this material holds the promise becoming widely adopted and commercially viable.

Abstract No. 0181 Yi-Chun,Lai

Prussian Blue Analogues (PBA) frameworks stand out among metal-organic frameworks due to their low cost, ease of preparation, excellent structural stability, porous structure, and rich redox properties. However, their limited electrical conductivity and significant volume expansion during cycling have hindered their broader application in sodium-ion batteries.In this study, by adjusting the amount of PVP and optimizing the carbon coating and selenization processes, we successfully synthesized size-controllable and high-capacity cubic CoSe structures (Figure 1). Thanks to their larger specific surface area, more stable carbon shell, enhanced electrical conductivity, and greater adsorption capability, these carbon-coated CoSe nanocubes exhibit outstanding electrochemical performance as an anode material. Specifically, the carbon-coated CoSe cubic nanocrystals achieved a discharge capacity of 1020 mAh g−1 at a current density of 0.05 A g−1 (Figure 2). This study presents a straightforward method for fabricating high-performance sodium-ion battery anodes, offering a novel solution for advancing this field.

Abstract No. 0182 CELASTIN BEBINA THAIRIYARAYAR

All-solid-state batteries (ASSBs) are gaining attention because its possible high energy density (> 400 Wh/kg). However, they face challenges from interface instability and the formation of unstable metal dendrites and byproducts. A polymer coating will suppress the dendrites, enhancing electrochemical reversibility and specific capacity. In this research, we explore an improving of Na_3SbS_4 pellet by applying a dual-sided polymer coating for enhancing battery performance. The polymer composes AAM950 polymer mixed with NaTFSI salt. This polymer coating enhances the surface quality by filling voids and pores on interface, resulting in a smoother interface and improved ion conduction. The Na_3SbS_4 electrolyte with polymer coating demonstrates an ionic conductivity of 0.35 mS cm^{-1} at 55°C. Moreover, the battery capacity with polymer coating increases from 92.7 to 137 mAh g^{-1}, maintaining a retention rate of 89.6% and a Columbic efficiency of 99.3% over 50 cycles, at a current density of 0.02 A/g and 55°C. These results indicate that employing a dual-side polymer coating approach shows promising performance of Na_3SbS_4 electrolytes for sodium-ion batteries.

Abstract No. 0183 HSU, JUI-HUNG

Compared with common carbon-based anodes, silicon is considered a potential anode material because of its high theoretical capacitance (4200 mAh/g), suitable lithiation potential, and rich reserves. However, its non-conductive nature, side reactions with the electrolyte and significant volume expansion during lithiation pose challenges in all-solid-state batteries.1, 2 In this work, an artificial Poly(acrylonitrile)-Sulfur (PAN-Sulfur) layer was manufactured on a silicon substrate. This artificial interface effectively restrains the volume expansion of the silicon anode and reduces side reactions with the electrolyte, while also enhancing ionic conductivity within the anode. With this approach, the first cycle coulombic efficiency was increased to 78%, and no short circuits occurred during the subsequent 100 cycles of charging and discharging. Additionally, in this study, no solid electrolyte was added to the silicon anode, thus avoiding further formation of solid electrolyte interface (SEI) and side reactions with silicon, while ensuring that the electrode maintains sufficient ionic conductivity.

Abstract No. 0184 You Zher Yu

NH4BF4 and NH4HF2 were used for the first time as structure-directing agents (SDA) to synthesize nickel manganese compounds as active materials for energy storage devices. The bimetallic compounds, composed of nickel hydroxide and manganese oxide, exhibit a favorable twodimensional flower-like structure with high surface area and abundant redox states. As shown in Figure 1, among the various nickel manganese compounds tested, NiMn11 displayed the highest specific capacitance of 1358.2 F/g, corresponding to a capacity of 226.4 mAh/g. The current density versus potential curves indicate that NiMn11 offers superior redox activity and charge storage capability compared to other ratios, such as NiMn21 and NiMn31, due to its optimal balance of nickel and anganese content, leading to improved electron/ion transport and enhanced energy storage efficiency. The energy storage device assembled using NiMn11 and reduced graphene oxide on nickel foam achieved a maximum energy density of 11.45 Wh/kg at a power density of 0.35 kW/kg. As show in the Figure 2, it also demonstrated excellent long-term stability, retaining 85.6% of its specific capacitance and 87.5% coulombic efficiency after 10,000 cycles, further validating its remarkable cycling stability, efficiency, and potential for high-performance energy storage applications.

Abstract No. 0185 Pin-Chun Lee

Zeolitic imidazolate framework-67 (ZIF67) with large surface area and tunable pore structure is intensively applied as a tailoring target for design active materials. An in-situ tailoring technique is proposed to design ZIF67 derivatives by using structure directing agents (SDA) to induce favorable morphology and composition. SEM results are shown in Figure 1. Ammonium fluoride is a common SDA for modifying surface properties of active materials. With the same ammonium and similar fluorine-based groups, NH4BF4 and NH4HF2 are priming to play as SDA for synthesizing ZIF67 derivatives. In this study, the performance of three ZIF67 derivatives for electrocatalytic water splitting was compared, and subsequently combined with a nickel-iron bimetallic organic framework (NiFeMOF) as an electrocatalytic electroactive electrode. Study combining different amounts of ZIF67 derivatives with nickel-iron bimetallic organic framework (NiFeMOF) to elucidate the growth mechanism of electroactive materials.

Abstract No. 0186 Ming-Yuan, Hung

As global energy demand continues to rise and fossil fuel supplies decline, effective energy storage technologies are crucial. Lithium-ion batteries (LIBs) have become the dominant choice, but traditional graphite anode-based LIBs are nearing their theoretical energy density limit. Lithium metal batteries have gained attention due to their high theoretical capacity (3860 mAh/g) and low electrochemical potential. However, lithium metal anodes face challenges such as capacity degradation and dendrite growth during charge-discharge cycles. Dendrites form as irregular deposits on the electrode surface, and repeated lithium plating and stripping can cause these dendrites to penetrate the electrolyte, leading to short circuits and reduced battery lifespan. Additionally, repeated cycling results in capacity loss, largely due to the formation of a solid electrolyte interphase (SEI) and dead lithium accumulation. This study simulates the capacity degradation and irregular deposition behavior of lithium metal anodes to understand the causes and mechanisms of these issues, aiming to propose strategies for mitigating capacity loss and improving battery cycle life. The findings will help optimize lithium battery technology for future energy storage solutions.

Abstract No. 0187 H. Tsou

Copper has attained indispensable status across diverse modern electronic and semiconductor applications, owing to its exceptional physical and electrical attributes. Notably, in response to the emergence of electric vehicles, copper assumes a critical role as a current collector for the negative electrode in lithium-metal batteries (LMBs). LMBs, distinguished by their high energy density in the absence of carbon-based active materials on the negative electrode side, hold immense promise for future energy storage endeavors. However, the commercialization of LMBs faces formidable challenges, including the instability of the solid electrolyte interphase, pronounced volume fluctuations, and dendrite growth of lithium. In light of the imperative to enhance the cycle life of LMBs through direct modifications to the current collector, we propose a novel approach involving the high electroplating of (111)-orientation nanotwinned copper with meticulously controlled morphology. This novel methodology is corroborated by a system-optimized electrochemical polishing system employing full factorial design principles.

Nanotwinned Cu (nt-Cu) represents a distinct crystalline structure characterized by twin-containing columnar grains. Its exceptional mechanical strength arises from twin boundaries (TBs) effectively impeding dislocation motion, thereby establishing the Hall-Petch strengthening relationship. For instance, nt-Cu demonstrates ultrahigh tensile strength, reaching approximately 1 GPa, far surpassing the 200 MPa achieved by coarse-grained Cu. Moreover, TBs contribute to enhanced thermal stability, preventing self-annealing phenomena that could alter Cu's mechanical properties. Given these advantages, incorporating high-density twin boundaries within Cu grains emerges as a promising strategy to enhance Cu interconnects' physical properties and reliability. Fortunately, a novel direct-current method, boasting a current density of up to 40 ASD, has been successfully developed for plating copper foils with densely packed (111) twin boundaries. This approach mitigates the time-consuming nature of pulse electroplating. The resulting foils exhibit the thinnest solid electrolyte interphase (SEI) formation compared to those plated with Cu (101) and Cu (001), attributed to the lower surface energy of Cu (111). This innovation complements traditional methods such as pulsed electro-deposition for manufacturing Cu deposits with dense twin boundaries.

However, a persistent issue arises in the form of uneven copper growth on the titanium plating substrate edges due to the Edge Effect. This uneven growth results in excessive copper accumulation at the edge, creating operational inefficiencies. To tackle this challenge, our approach involves utilizing electropolishing techniques (EP) to flatten the copper foil current collector while preserving its crystal orientation and defect structure integrity. By doing so, we aim to achieve a more uniform copper distribution across the substrate, thereby enhancing the performance and efficiency of the electrical system.

The electropolishing technique stands out as a remarkably efficient method for cleaning and enhancing the appearance of metals and alloys. Its efficacy has garnered significant attention both in practical applications and academic research. Numerous efforts have been made by researchers and practitioners to achieve bright and smooth surfaces on metals such as copper through the application of electropolishing methods. Several factors must be carefully considered in electropolishing, including mass transformation, choice of electrolyte, and additives. During the process, the stripping rate of copper ions often outpaces their diffusion rate, resulting in a notable accumulation of copper ions near the surface of the copper foil. This accumulation can trigger uncontrollable concentration polarization, presenting challenges in maintaining uniformity. Consequently, this phenomenon gives rise to inconsistencies in the limit current of the copper foil, resulting in uneven electropolishing rates across the surface. These variations significantly impair planarization efficiency. Additionally, the electropolishing rate of copper metals predominantly hinges on two key factors: the acidity of the solution and the resistance of the viscous layer, confirmed by alpha-step and AFM. By manipulating the electrolyte's acidity and viscosity, we can fine-tune the proportion of the electrolyte, whereby controlling the limit current without succumbing to the effects of concentration polarization. This adjustment enables us to optimize the surface morphology of the copper foil, achieving desired results effectively.

In this study, we employed design of experiment (DOE) to systematically investigate the electropolishing effect under varied conditions, encompassing factors such as distance between two electrodes, mass transformation, and different electrolyte proportions. Through statistical analysis, we systematically summarized the correlation between the roughness of the copper foil and the factors of electropolishing and develop a regression model for the composite factors, and also conduct the steepest ascent test to validate the accuracy and reliability of our regression model. As well, we correlated our findings with the electrochemical behavior observed during copper foil electropolishing. This comprehensive analysis provides valuable insights into the mechanisms and properties underlying the formation of surface profiles, enhancing our understanding of the process.

Abstract No. 0188 Tsung-I Yeh

This research combines sulfides (Argyrodite structure) with excellent lithium ionic conductivity with a polymer to obtain an ultra-thin solid-state electrolyte membrane. The mechanical strength of the solid-electrolyte membrane is crucial for the electrochemical performance of sulfide-based all-solid-state lithium batteries. However, the mechanical properties of solid-state electrolytes are insufficient for their practical applications. Meanwhile, sulfide electrolytes' structural decomposition occurs at a high charge state or high potential, which results in the performance fading of sulfide-based all-solid-state lithium batteries.

This study uses in-situ mono-beam diffraction techniques to assess the phase structures transformation/grains boundary change of the solid-state electrolyte membrane upon charge/discharge1. It is anticipated to understand the mechanism of interfacial reactions at different states of charge (SOC). Further, X-ray absorption spectroscopy was used to analyze absorption near edge changes at the absorbing elements and investigate the decomposition mechanism of Argyrodites and their compatibility between cathodes and electrolytes.

Abstract No. 0189 Wei-Cheng Chen

Sodium-ion battery (SIB) is one of potential alternatives to lithium-ion battery, because of abundant resources and lower price of sodium. High electrical conductivity and long-term durability of MXene are advantageous as the anode material of SIB, but low energy density restricts applications. Tin phosphide possesses high theoretical capacity, low redox potential, and large energy density, but volume expansion reduces its cycling stability. In this study, tin phosphide particles are in-situ encapsulated into MXene conductive networks (SnxPy/MXene) by hydrothermal and phosphorization processes as novel anode materials of SIB. MXene amounts and hydrothermal durations are investigated to evenly distribute SnxPy in MXene. After 100 cycles, SnxPy/MXene reaches high specific capacities of 438.8 and 314.1 mAh/g at 0.2 and 1.0 A/g, respectively. The capacity retentions of 6.0% and 73.6% at 0.2 A/g are respectively obtained by SnxPy and SnxPy/MXene. The better specific capacity and cycling stability of SnxPy/MXene are attributed to less volume expansion of SnxPy during charge/discharge processes and relieved self-stacking of MXene by encapsulating SnxPy particles between MXene layers. Electrochemical impedance spectroscopy and Galvanostatic intermittent titration technique are also applied to analyze the charge storage mechanism in SIB. Higher sodium ion diffusion coefficient and smaller charge-transfer resistance are obtained by SnxPy/MXene.

Abstract No. 0190 Hsin-Chi Liu

Anode-free lithium-metal batteries not only achieve higher energy density but also offer advantages such as reduced manufacturing complexity and cost due to their design, which eliminates the need for an anode material. The $LiNi_{0.5}Mn_{1.5}O_4$ (LNMO) cathode, with its 4.7 V flat voltage platform and lower cobalt dependency, shows great potential in practical applications.[1] However, high voltage introduces challenges such as electrolyte decomposition, instability at the electrode/electrolyte interface, gas generation, and transition metal dissolution.[2] High-concentration electrolytes (HCE) help mitigate these challenges, but raising the concentration of lithium salts also increases the electrolyte's viscosity, which in turn lowers ionic conductivity and wettability, negatively impacting battery performance. By incorporating diluents into high-concentration electrolytes, localized high-concentration electrolytes (LHCE) are formed, enhancing the stability and performance of high-voltage cathodes.

This study uses lithium hexafluorophosphate (LiPF6), ethylene carbonate (EC), ethyl methyl carbonate (EMC), and dimethyl carbonate (DMC) as HCE components, with 1,1,2,2-Tetrafluoroethyl-2,2,3,3-tetrafluoropropylether (TTE) as a diluent to form LHCE. Traditional carbonate-based electrolyte (1.2M LiPF6 in EC/EMC (volume ratio 3:7)) was used as a reference. In comparison, the use of LHCE provides better cycling performance.

Abstract No. 0191 Hsieh, Han-Hsuan

Compared to the mature technology of commercial lithium-ion batteries, anode-free lithium metal batteries (AFLMB), in the absence of Li metal on the Cu substrate, often experience rapid capacity loss due to the irreversible consumption of lithium. Fluoroethylene carbonate (FEC) is considered an effective electrolyte additive to improve the long-term cycling performance of lithium metal batteries. The addition of FEC can promote the formation of LiF, enhance lithium-ion conductivity in the surface area, and reduce interface resistance, thereby improving the stability of the solid electrolyte interface (SEI). Therefore, understanding the composition of the SEI and its impact on LiF crystal formation is essential. In this study, we used FEC (5%, 10%) in 1 M LiPF6 EC/DEC (1:1 v/v) Li||Cu batteries to investigate the relationship between electrolyte composition and the formation of the initial SEI. We used X-ray scattering to study the effect of different concentrations of FEC on LiF crystal formation and confirmed whether the addition of FEC promotes the formation of LiF structures with specific crystal orientations. By selecting the appropriate concentration of the additive, the amount and distribution of LiF can be adjusted, promoting the formation of a thin and uniform SEI layer.

Abstract No. 0192 Wen-Chen Tsai

Lithium-ion batteries are vital in modern life and technology due to their high energy density, efficient charge-discharge cycles, and long lifespan. However, they face safety challenges like thermal runaway, overcharging, and structural damage, which can lead to fires and explosions. Addressing these safety concerns is critical for the future development of lithium-ion batteries.

This study developed a phosphate-based electrolyte with flame-retardant properties. This electrolyte was used in batteries with LiMn2O4 (LMO) as the cathode. The electrolyte formulation was based on LiClO4 and triethyl phosphate (TEP) in a molar ratio of 1:3.5. It was further enriched with 5wt% vinylene carbonate (VC) and 2wt% LiNO3 as additives, named LTV5 and LTV5N2, respectively. In the Flammability test, both LTV5 and LTV5N2 demonstrated excellent flame-retardant properties. During the lithium plating/stripping testing in the Li//Li symmetric cell with current density of 0.5 mA/cm2, LTV5 showed an initial overpotential of 0.36V, which increased to 1.2V after 350 hours of repetitive plating/stripping cycles. In contrast, LTV5N2 had a lower initial overpotential of 0.2V, and even after 350 hours of plating/stripping cycling, it only increased to 0.36V. In the Li//LMO half-cell tests, the initial discharge capacity of the cell with LTV5 was 90 mAh/g, which dropped to 8 mAh/g after 1500 cycles. In contrast, the cell using LTV5N2 had an initial discharge capacity of 98.5 mAh/g and retained 45 mAh/g after 1500 cycles. This study indicates that using LiClO4 and TEP as an electrolyte in lithium-ion batteries provides good flame retardancy and superior charge/discharge performance.

Abstract No. 0193 Yu-Chi Wang

"Polymer incorporating lithium salt has emerged as a cost-effective, chemically stable, and lithium-ion-conductive solid electrolyte. However, the low room ionic conductivity (~10-6 S/cm) and low transference number (averaged at ~0.1) of it restrict the practical application1. To overcome these challenges, a deeper understanding of Li+ transfer mechanism within polymer-lithium salt matrix is crucial. Herein, we report the anisotropic ionic transport behavior in polyethylene oxide (PEO) combined with Lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) electrolytes and demonstrate how through-plane and in-plane configurations in cell assembly influence their ionic transport properties. A specially designed pouch cell device was employed in this work, and an electrochemical methodology with impedance spectroscopy (EIS) and steady-state polarization was introduced to analyze ionic conductivity and cationic transference number within the same PEO-LiTFSI film. The polarized optical microscopic (POM) images were used as well to distinguish the amorphous and crystalline regions of PEO-LiTFSI under certain temperatures. To enhance theoretical understanding, finite element simulations based on POM images were conducted for electrochemical impedance analysis. We observed significantly higher cationic transference number in the in-plane configuration compared to the through-plane configuration. To elucidate the phenomenon, detailed knowledge of the local Li+ transport properties within the entire electrolyte is critical. Nonetheless, the coexistence of crystalline and amorphous regions within the system complicates the analysis2, and the precise effects of these two phases on the ion transport have remained unclear. Therefore, in our research, we separately characterized the local Li+ transport properties of these phases at room temperature via two-point probe measurement coupled with finite element simulations. Our findings provide valuable insights into the Li+ transport pathways within PEO-LiTFSI solid-state electrolyte systems. Applying our concept to size engineering of polymer spherulites and optimization of film thickness can significantly raise the Li+ transference number, mitigating lithium dendrite formation, and offers the potential to address critical issues in the application of polymer solid electrolytes in next-generation all-solid-state lithium-ion batteries.

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Abstract No. 0194 羅友捷

Electronic synaptic devices, which is a type of electrochemical three-terminal transistor, are now considered ideal platforms for neuromorphic computing. While two-terminal memristors or C-MOS silicon technologies have been explored as potential candidates in recent years, several issues—such as filament formation, nonlinear switching, and excessive energy consumption—restrict their computing efficiency. In synaptic transistors, applied pulse to the gate electrode allows for temporary or long-term modulation of channel conductance. However, this nonvolatile characteristic is not yet fully investigated. In this work, we use the finite element method to comprehensively explore the physics and chemistry within the device. The simulation involves the Nernst-Plank equation, Poisson equation, Nernst equation, and Butler-Volmer equation to model the transport and electrochemical kinetics of charge species in different phases in the device. The results show that the relaxation time constant and the resting current value are influenced by concentration gradient and electric field in the mixed-electronic-ionic-conducting channel.

Abstract No. 0195 Yi-Fen Hung

Solid-state lithium batteries are emerging as next-generation energy storage solutions due to their superior safety, energy density, and cycle life compared to traditional liquid lithium-ion batteries. By using solid electrolytes, they eliminate risks like leakage and fire. Solid polymer electrolytes (SPE), such as polyethylene oxide (PEO), are crucial for their lightweight, flexibility, and ability to inhibit lithium dendrite growth, thus enhancing battery reliability.

In this study, we utilized in situ confocal optical microscopy to analyze dendrite growth mechanisms and the effects of different lithium salts on Li deposition. We examined PEO-based SPEs with two lithium salts: 20 wt% Lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) and Lithium bis(oxalate)borate (LiBOB) in a Li||Cu configuration. PEO-LiTFSI showed uniform deposition with mossy dendrites, while PEO-LiBOB exhibited uneven deposition with needle-like dendrites, potentially posing safety risks. Insights from this study aim to enhance the safety and performance of all-solid-state batteries.

Abstract No. 0196 Chang-Lin Liu

In recent years, sulfide solid electrolyte is often used in all-solid-state lithium-ion batteries because of its advantages such as thermal stability and high conductivity. Because of its poor strain and easily cause cracks during the charge/discharge of the battery by the growth of lithium dendrites. Therefore, it is very important to prepare solid electrolyte membrane with good mechanical properties.

This research mainly focuses on the preparation of solid-state electrolyte membranes with high mechanical strength and thickness controllability through UV-curing process. ETPTA polymer mentioned in reference1 was used as the substrate of the membrane and Irgaure 819 photo-initiator was added to prepare the UV cured membrane. Currently, the highest conductivity can reach 0.3-0.4 mS/cm and has a high mechanical strength of 12 MPa. However, critical current density (CCD) is 0.01 mA/cm2 in Li-Li symmetric battery for its brittleness property. By add PMMA polymer to copolymerize with ETPTA to made membrane become more tough, and will also add Li salt to prepare gel-polymer electrolyte to lower the impedance. Expected to reach the 1 mA/cm2 of CCD and excellent performance in LCO/LPSC | SSE | In full battery system.

Abstract No. 0197 Yu-Ting Tai

All-solid-state batteries present a promising alternative to traditional Li-ion batteries, offering higher energy density and enhanced safety. However, their widespread application is impeded by challenges such as high interfacial resistance. Both experimental and computational studies have identified cation interdiffusion as a significant phenomenon at these interfaces, exemplified by Co-diffusion from the cathode LiCoO2 to the solid electrolyte Li1+xAlxTi2-x(PO4)3 (LATP). However, the impact of cation interdiffusion on interfacial resistance, particularly Li-ion transport, remains unclear. Therefore, our study employs first-principles calculations to analyze Co insertion into LATP and its effect on Li-ion conductivity. The results indicate that Co insertion notably impedes Li-ion transport in LATP near the LATP/LCO interface, resulting in an increased activation energy of 0.08 eV during both charging and discharging processes, along with a decrease in ionic conductivity from 0.5 mS/cm to 0.03 mS/cm. This suggests that at the LATP/LiCoO2 interface, Co migration trapped Li-ions in local lattices, raising interfacial impedance. Therefore, preventing Co migrating from the electrode material to the solid electrolyte is key to enhancing interfacial impedance. These findings offer valuable insights for enhancing interfaces in all-solid-state batteries performance.

Abstract No. 0198 **Hsing-Mei Chou**

With the professional and advance progress of semiconductor industry, the part of recovering heavy metal ions from wastewater in semiconductor factories has increasingly its importance.Especially with the high market demand for copper, the recovery of copper ions has gained more attention. Most comman methods of recoverying Cu2+ among chemical precipitation, ion exchange, membrane filtration, electrochemical processes and so on. However, those methods might face some predicaments including the need for chemical reagents and the generation of additional pollutants will lead to an increase in costs.In this study we utilize electrochemical capacitive deionization (ECDI) which can remove the salt ions from aqueous saline media by applying lower electrical potential as the driving force . Carbon materials are widely discussed as electrode materials in ECDI due to their simple synthesis and high electron conduction speed. However, electric double-layer adsorption mechanism and the co-ion effect limit the development of the carbon materials system. Hence, to further enhance the ECDI system's capability for Cu2+ recovery. By introducing sodium manganese oxide composed with actived carbon (NMO@AC) as the positive electrode and polypyrrole (PPy) as the negative electrode to construct an asymmetric pseudo-capacitive//pseudo-capacitive type desalination system. This system utilizes the ion removal mechanism of charge transfer in Faradaic materials to achieve efficiently recover in Cu2+. Additionally, through the memory effect of Faradaic materials, we can realize an efficient, membrane-free Cu2+ recovery process.

All desalination performances of AC//PPy and NMO@AC//PPy system were examined using a flow-by ECDI cell. To determine the influence of varying salt concentrations on the desalination performance of ECDI cells, two concentration types of Cu2+ solutions (60ppm and 600ppm) are used.

The results show that the SAC(mg/g) of NMO@AC//PPy system improves approxite 40% than AC//PPy system.The removal mechanism of Cu2+ is further discussed through XRF, EPMA, XPS, and XRD, providing a guiding framework for the development of materials for the recovery of such heavy metal ions.

Abstract No. 0199 Yu-Chun Liu

CO2 electroreduction reaction (CO2RR) has the potential to efficiently convert CO2 into valuable products like C2H4, but the inherent stability of CO2 molecules still limits CO2RR conversion and results in slow kinetics. Tandem catalysis presents a promising strategy for converting CO2 into CO and subsequently forming multicarbon (C2+) products more efficiently. Single-atom catalysts (SACs) have demonstrated significant potential in reducing CO2 to CO. Therefore, integrating SACs with copper catalysts can enhance overall CO2RR activity. In this study, we developed a tandem catalysis system by combining a three-dimensional covalent-organic-framework single-atom catalyst (3D COF SAC), as evidenced by X-ray absorption spectroscopy, with copper nanowire. The 3D COF SACs offer numerous highly active sites for CO generation due to d orbital regulation by the linkage of individual single-atom structures, as unveiled by X-ray emission spectroscopy and resonant inelastic X-ray scattering. The generated CO then diffuses onto the copper surface to produce C2H4. We observed a waning and waxing correlation between CO and C2H4 production as a function of reductive potential, demonstrating the tandem behavior. Our tandem system achieves a Faradaic efficiency of 67.6% for C2H4 at 1400 mA cm-2, with a C2H4 current density of 946.4 mA cm-2, overperforming the benchmark copper catalyst by 100% in C2H4 current density. We believe that our tandem CO2RR design can contribute significantly to achieving Net Zero emissions by 2050

Abstract No. 0200 陳姿均

Fuel cell is an efficient and low-pollution technology that convert chemical energy into electricity. Hydrogen is one of the most common fuels; however, there are many challenges for its storage and transportation. With increasing population in the world and the development of animal husbandry today, large amounts of urea are discharged in daily lives as a waste while it is a potential fuel to drive electrochemical cells. To employ urea for electric power generation involves a slow oxidation reaction that involves six electron transfer. A good electrocatalyst is a key to speed the process. Based on our earlier studies, nickel is a good candidate among all metals investigated. In this study, we explored a catalytic system based on a metal foam by incorporating nickel in a metal organic framework as active sites and modifying the surface with polyprrroles to increase conductivity. Preliminary studies on the lifetime and the performance of this catalyst were presented.

Abstract No. 0201 Hong-Zhang Huang

All-Solid-State Batteries (ASSBs) are promising for energy storage and provide solutions to mitigate the safety issues linked to flammable organic liquid electrolytes, while simultaneously enhancing safety and energy density. A composite positive electrode (CPE) combines active materials (AM) with solid electrolyte (SE) to enhance transport and contact areas. However, CPE is unable to mitigate the capacity fading observed during ASSBs cycling, primarily due to the volume changes of AM. Establishing the relationship between particle size and distribution in CPE and its impact on ASSB performance is challenging. Therefore, in this work, we constructed a 2D continuum model based on different compositions of ASSBs incorporating a CPE. To simulate the battery's capacity, we employed Finite Element Analysis (FEA), utilizing the electrochemical reactions and diffusion of Li-ions in SEs and electrodes. This model's geometry is tuneable via scripts, we utilize code to randomly generate AM particles with different sizes while controlling the overlap ratio. This model allows us to investigate the impact of various AM particle sizes, AM distribution, volume ratios, and the contact area between AM and SE. The LCO/LLZO composite experiment achieved a capacity of 0.63 mAh/cm2[1], and simulation using a 50% contact area matched the experiment's discharge curve and capacity. On the other hand, employing a softer SE LGPS, simulation with a 70% contact area matched the capacity of 123 mAh/g in the LCO/LGPS composite experiment[2]. The simulation results agree with mechanical properties of SEs. In this study, we extend to explore the training of machine learning models using various activation functions and output features, resulting in a total of 3,096 combinations across deep neural networks with 4, 5, and 6 layers. Our findings indicate that the 5-layer model provides the best performance, achieving the lowest prediction error for contact area.

Abstract No. 0202 Felika Valencia

Anode-free lithium metal batteries offer high energy density, cost savings, and safer production. However, lithium dendrites and unstable SEI are challenges. We propose tuning the electrolyte formulation to create an anion-rich solvation structure that promotes a more stable, anion-rich SEI. Imide-based salts are considered promising candidates for next-generation Li-ion batteries due to their superior chemical stability and high ionic conductivity.[1] Besides, it is also less prone to moisture resulting in low transition metal dissolution.[2] However, commercial imide-based salts often contain trace amounts of LiCl, which can lead to corrosion of the aluminum (Al) current collector at voltages higher than 4.0 V.[3] Al corrosion will cause several problems such as its solid products will increase the electrical resistance and its soluble products will contaminate the electrolyte and increase the self-discharge rate. Moreover, the dissolved Al3+ ions migrate to the anode and reductively deposit that increase its internal resistance. To address this issue, we propose the addition of commercialized LiPF6, known for its excellent stability with Al current collectors, to form a protective passivation layer.[4] At the same time, we take advantage of the good compatibility of dual-salt electrolytes, combining the benefits of both salts. In this study, instruments such as X-ray Photoelectron Spectroscopy (XPS), Raman Spectroscopy, Transmission X-ray Microscopy (TXM) and Scanning Electron Microscopy (SEM) will be used to investigate such evidence.

Abstract No. 0203 Ervina Nur Azizah

Nickel-rich layered oxides cathode, such as LiNi0.88Co0.09Al0.03O2 (NCA), offer high specific capacity (> 200 mAh g-1) and high energy density (>750 Wh kg-1), with Al can improve the structure and thermal stability. Normally, the cut-off voltage of NCA is set at 4.3 V due to balance of performance and safety considerations. Whereas, theoretically increasing cut-off voltage can promote higher energy density. However, higher cut-off voltage can undergo structural degradation, electrolyte decomposition, and thermal stability which leads to poor cycle life and capacity fading. In this work, lithium trifluoromethyl benzimidazole (LiTFB) was used as salt additive electrolyte to stabilize NCA at a higher cut-off voltage up to 4.5 V vs. Li/Li+. Cyclic voltammetry result reveals that NCA with LiTFB salt additive have stable redox peaks and minimal shifts, while the capacity retention improve from 80% to 88.3% after 100 highlighting the additive’s potential for high-energy application.

Abstract No. 0204 Salva Salshabilla

Anode-free lithium-ion batteries system have gained significant attention due to their high energy density. The electrochemical performance of this system is determined mainly by the uniformity of lithium metal deposition onto current collector (commonly copper). It is known that Cu tends to be covered by a thin oxide layers consist of CuO, Cu_2O, or CuOH when exposed to ambient atmosphere. During the lithium plating process this thin oxide layers induced a conversion reaction as follow: CuO+〖2Li〗^++〖2e〗^-→Cu+Li_2 O. Cu foil suffer from volume expansion, low Coulombic efficiency, and poor cycle stability because of this conversion reaction, which then impair the battery performance. Thus, removing the oxide layers in the Cu current collector is necessary. Acid cleaning treatment used high molarity of strong acids like HCl and HNO3 can be used to analyze the surface characteristics and behavior of the Cu current collector. In this work, we present an overview of the different acid cleaning treatments of Cu current collector and discuss various strategies to remove copper oxides and analyze its electrochemical behavior.

Abstract No. 0205 **Shen-Fa Dung**

The development of lithium-ion batteries has matured; however, rapid advancements have led to a significant decline in lithium availability. As a result, sodium-ion batteries, utilizing sodium metal that is rich in supply and cost-effective, have attracted considerable research attention. Antimony selenide is a promising anode material for sodium-ion batteries due to its high theoretical capacity and excellent conductivity. However, volume expansion from the alloying reaction between antimony and sodium can cause pulverization, negatively impacting long-term cycling performance. This study aims to address these challenges through defect chemistry modifications.Bismuth, a group member of antimony that can be mixed in any molar ratio, was chosen as the dopant. To reduce capacity loss due to the dopant's lower theoretical capacity, selenization was performed during the one-step hydrothermal synthesis of BiSbSe. Various molar ratios of antimony to bismuth were examined for their effects on capacity and stability. The optimized 1:2 (BiSbSe12) ratio achieves a specific capacity of 576.1 mAh/g at a current density of 1.6 A/g (Figure 1). After 30 cycles at 0.1 A/g, it retains 506.3 mAh/g, with a capacity retention rate of 94.7% (Figure 2). Compared to the undoped Sb2Se3 electrode, the BiSbSe12 electrode shows improved rate performance and stability.

Abstract No. 0206 **Somya Samantaray**

The development of efficient and stable electrode materials is crucial for advancing supercapacitor technology. In this study, a novel activated carbon/SrFe12O19 (AC/SFO) composite was synthesized through a simple one-step refluxing method, utilizing activated carbon (AC) derived from bamboo leaves via high-temperature carbonization at 800 °C for 2 h. This low-cost and sustainable process for AC production presents an environmentally friendly alternative. The AC/SFO composite was then evaluated as a cathode material for supercapacitor applications. The synergistic combination of AC and SrFe12O19 perovskite in the composite led to notable improvements in electrochemical performance. The supercapacitor exhibited a high specific capacitance of 572.3 F g-1 and maintained 85% of its initial capacitance after 3000 charge-discharge cycles at a current density of 1 A g-1, demonstrating excellent cycling stability. Furthermore, the composite displayed outstanding dielectric and impedance properties, contributing to enhanced energy storage capability. The incorporation of bamboo-leaf derived AC into the SFO matrix significantly influenced the electrochemical behavior of the composite compared to bare SFO. A detailed investigation into the energy storage mechanism revealed key factors contributing to the improved capacitive performance of the AC/SFO material. These findings highlight the potential of AC/SFO composites as promising electrode materials for high-performance supercapacitors.

Abstract No. 0207 Min-Jay Deng(鄧名傑)*

As a result, there has been growing interest in developing zinc-ion hybrid supercapacitors (ZHSCs) as an alternative to LIBs due to their inherent safety, low cost, excellent stability, and high power and energy density. ZHSCs hold significant potential for advancing the market for next-generation wearable health electronics.[1]

Our findings show that the NiCo hydroxides/CC//Mn oxide/CC ZHSC exhibited outstanding capacitive properties, with an operating voltage as high as 2.1 V and excellent cycle stability (up to ~10,000 cycles). This remarkable energy storage performance can be attributed to the high theoretical specific capacitance and rich redox-active sites of NiCo hydroxides, as well as the enhanced electrochemical reversibility and improved electron/ion transfer efficiency between the electrodes and the PAAM-ZnCl2-Acetamide (PaZA) electrolyte. As a result, the ZHSC achieved an ultra-high energy density of over 40 Wh/kg at a power density of > 500 W/kg. Moreover, the chemical structure of NiCo hydroxides/CC was further investigated using synchrotron radiation analysis, and in-situ X-ray absorption spectroscopy was employed to examine the oxidation state changes during the charge/discharge process. These findings demonstrate that the 2.1 V flexible ZHSC developed in this study has numerous advantages, including high flexibility,excellent electrochemical performance. Its unique design and performance make this ZHSC a promising candidate for sustainable and lightweight wearable electronics.

Abstract No. 0208 錢彥銘

The study investigated B-site doped lanthanum strontium titanate (LST)-modified NiO/YSZ as a cathode for CO2 reduction in a solid oxide electrolysis cell (SOEC). Among LST, LSTC, LSTN, and LSTF, the LSTC doped SOEC not only outperformed pure NiO/YSZ in CO2/H2 conditions but also exhibited the best electrocatalytic activity. The high performance of the LSTC-modified cathode is attributed to its excellent CO2 reduction capability, as evidenced by infrared and temperature-programmed surface reaction studies. X-ray diffraction (XRD) and scanning electron microscopy (SEM) revealed that LSTC exsolves cobalt nanoparticles that adhere to the surface and alleviates stress induced by Ni oxidation, maintaining cathode structural stability and enhancing the electrical performance. These findings suggest that combining B-site doped LST oxides with Ni cermet in SOECs holds potential for energy conversion applications.

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Abstract No. 0209 Shao-Wei Lu

Electrocatalytic conversion of carbon dioxide (CO2) into fuels and high-value chemical products has become an intriguing field of research. Herein, bismuth (Bi) metal salts are introduced into a porous carbon network structure, Bi-ZIF-8, formed through the creation of a zeolitic imidazolate framework (ZIF-8), and a silicon dioxide (SiO2) coating is applied on the Bi-ZIF-8. This coating effectively prevents irreversible fusion and aggregation during the high-temperature calcination process. The results demonstrate that, after the high-temperature calcination step, the Bi-ZIF-8 with the SiO2 coating maintained its original structure while preventing the aggregation of Bi during pyrolysis. Additionally, by adjusting the Bi content, the HER reaction can be effectively suppressed (with FEH2 < 8%). These findings suggest that the synthesis of Bi-ZIF-8 with an SiO2 coating offers a promising pathway for CO2 reduction.

Abstract No. 0210 Yo-Hsuan CHEN

Na2/3Mg2/9Cu1/9Mn2/3O2 (NMCMO), a p2-type layered oxide, is a promising cathode material in sodium-ion batteries due to its high energy density. However, it often undergoes irreversible P2-O2 phase transformation when desodiation happens during the charging process. Na0.62K0.05Mg0.22Cu0.11Mn0.67O2 (NKMCMO), doping K to replace some Na ions in the alkali metal layer in NMCMO, helps increase and sustain the interlayer spacing, which avoids the phase transformation, and thus improves the structural stability. In this work, the first principle density functional theory (DFT) is employed to investigate the effect of NMCMO modified with K. It is obtained that the interlayer spacing increases, which could lead to better Na diffusion. Furthermore, by checking the electronic structure, it is proved that K-doping doesn’t change the mechanism of redox. Eventually, Ab initio molecular dynamics (AIMD) simulations are employed, showing that NKMCMO successfully maintains the P2 phase instead of the P2-O2 phase transformation during the charging process at room temperature. Thus, the structural stability of NMCMO is improved by K-doping.

Abstract No. 0211 Pei-Hsing Chia

Lithium metal batteries (LMBs) are highly favored due to their high theoretical capacity and low redox potential, but the problem of lithium dendrite formation limits their practical applications. According to Sand's formula, adjusting ion transport in LMBs can extend the nucleation time of dendrites and promote uniform lithium deposition to suppress dendrite growth1, 2. In this study, a titanium-based metal-organic framework (MOF) was used to modify the copper current collector. The intrinsic nanochannels in MOFs as “ionic sieve”, restricting the migration of larger anions and thereby regulating ion transport to reduce lithium dendrite formation. Additionally, the MOF as an artificial modification layer, which can also reduce volume changes during the lithium plating and stripping. Through this method, stable lithium plating and stripping for over 500 hours was achieved in a lithium-copper half-cell system.

Abstract No. 0212 Chun-Jung Chang

To achieve carbon neutrality by 2050, effective conversion as well as utilization of carbon dioxide (CO_2) is essential. This research, particularly, aims at the utilization of carbon dioxide via electrocatalysis to produce formate. We proposed a two-dimensional (2D) nanosheet-like electrocatalyst for the electrochemical carbon dioxide reduction reaction (eCO_2RR). Maleic anhydride (MA) was used as the organic ligand to react with bismuth(III) (Bi(III)), by solvothermal method, for the synthesis of Bi-organic materials, which is notated as BiMA. Subsequently, the 2D nanosheet-like electrocatalyst, notated as (BiMA)cv, was derived from pristine Bi(III)MA by cyclic voltammetry. Both pristine BiMA and (BiMA)cv were observed and characterized by SEM images and XRD spectra, respectively. XRD spectra show the formation of 2D nanosheet-like (BiMA)cv crystal from amorphous BiMA after cyclic voltammetry. Both pristine BiMA and (BiMA)cv, as the active materials of electrocatalysts, were fabricated onto carbon paper (CP) as the cathode to proceed eCO_2RR. The main product from eCO_2RR is formate while simultaneously hydrogen and carbon monoxide are by-products. We discovered that, from the aspect of electrocatalysts for eCO_2RR, (BiMA)cv shows superior performance than BiMA. With the (BiMA)cv modified electrode, overall current density of 26 mA cm^{-2} as well as a Faradaic efficiency of formate of over 90% could be achieved at -1.2 V (vs. RHE). Consequently, the formate formation rate of up to 400 μmol mA cm^{-2} h^{-1} was obtained. Additionally, (BiMA)cv still maintained its nanosheet-like morphology after two hours of operation without any visible damage. Concluded from the above mentioned, the (BiMA)cv demonstrates its potential as an electrocatalyst for the electrochemical reduction of CO_2 to formate, making it a promising candidate for eCO_2RR applications.

Abstract No. 0213 Yu-Ching Wen

In this study, we have strategically designed a Si/Sn/C composite material as an anode for lithium-ion batteries (LIBs), leveraging the synergistic effects of these three elements to achieve enhanced electrochemical performance, including high specific capacity and improved cycling stability. Silicon and tin are known for their high theoretical capacities, but they suffer from significant volume expansion during lithiation and delithiation, which leads to rapid capacity fading. To address this challenge, we employed high-energy ball milling (HEBM) to synthesize a composite that combines the mechanical strength and conductivity of carbon with the active material properties of silicon and tin. The composite structure generated through HEBM provides a stable framework, allowing for better accommodating volume changes. This results in a specific 1405 mA h g−1 capacity at 0.3 A g−1, with over 90% capacity retention after 50 cycles. The composite also performs well under high current densities, making it suitable for high-power applications. Cyclic voltammetry and galvanostatic charge-discharge tests were conducted to investigate the kinetic properties and rate capabilities of the composite. Additionally, a transmission X-ray Microscope is utilized to observe the restricted volume expansion of the material particles. The role of each element within the Si/Sn/C system was examined, revealing that the optimized ratio of these components results in a material with balanced energy density, durability, and rate performance, positioning it as a promising candidate for next-generation LIBs.

Abstract No. 0214 Hong-Ping LIN

In this study, nitrogen-doped graphitic multiporous carbon (denoted as: N-GMPC) materials with large specific surface areas, high nitrogen content and electric conductivity are obtained from a high-temperature activation on a simple mixture of powder of wasted oyster shell, KOH and biochars. The biochars are made from the the agricultural-waste, such as water chestnut shell or acacia wood. The experimental results show that the N-GMPC synthesized by these agricultural and fishery wastes have large specific surface area of 1638 m2 g-1, rich N-doping level of 4.2 wt% and high conductivity of 20.6 S/cm. After assbling to the coin cell, the supercapaciot of the N-GMPC also has high specific capacitance value (>100 F g-1) and high cycle life (10000 cycles, specific capacitance value > 80 %) in coin cell (CR 2032). Furthermore, in high voltage electrolytes (1.0M SBPBF4/ADN electrolyte), N-GMPC has higher specific capacitance (207 F g-1), higher energy density (61.19 Wh kg-1) and power density (23.22 kW kg-1). In summary, we present a simple blending method that enables the synthesis of high-quality N-GMPC. This approach requires minimal chemical reagents and eliminates the need of inert gas during the activation process. This method addresses Taiwan's agricultural and fishery waste issue, converting it into valuable activated carbon for eco-applications like water purification[1] and energy storage[2]. Aligned with the circular economy concept, this synthetic method demonstrates both environmental sustainability and commercial potential.

Abstract No. 0215 Kalpana Settu

Laser-induced graphene (LIG) electrodes have emerged as the prominent tool for developing sensors and energy storage devices due to the easy, affordable, and scalable manufacturing process. Conductive porous structured LIG can be formed by directly irradiating a polyimide sheet with a laser [1]. This laser-based technique for fabricating graphene demonstrates its unique benefits, which include selective and localized reduction, patterning flexibility, the absence of chemicals and gases, and the ability to perform the patterning in an ambient atmosphere without material wastage. Planar and flexible supercapacitors are becoming more popular among energy storage devices for wearable electronics because of their notable qualities, such as high power density, excellent lifetime, lightweight design, and the capacity to operate in mechanical deformation. In this study, a graphene-interdigitated electrode-based flexible supercapacitor was developed on a polyimide film by direct laser engraving approach under atmospheric conditions. Graphene oxide (GO) was coated on polyimide film and dried. The interdigitated electrode pattern to be engraved on GO coated polyimide film was drawn using AutoCAD software. Then, a CO2 infrared laser of wavelength 10.6 μm was employed to fabricate GO- laser-induced graphene (GO/LIG) composite electrode on polyimide film. The fabricated interdigitated bare LIG and GO/LIG electrodes were characterized by measuring capacitance in air. The interdigitated electrodes exhibited capacitance values of 2.4 pF and 32.7 pF for bare-LIG and GO/LIG, respectively. GO-LIG composite electrode revealed higher capacitance than LIG due to the oxygen-containing functional groups on its basal planes [2]. The supercapacitor was assembled in KOH and NaOH electrolytes using the LIG and GO-LIG electrodes, and an electrochemical evaluation was carried out. The electrochemical study showed a consistent response from the laser-induced graphene electrodes. These findings confirmed that electrochemical energy storage device patterning on flexible substrates could be achieved using the laser-induced graphene technique.

Abstract No. 0216 Yu-Wei Chuang

Lithium-sulfur (Li-S) batteries are attracting considerable interest as a next-generation energy storage system due to their outstanding theoretical energy density and affordability. However, their commercialization faces obstacles, including the shuttle effect caused by soluble polysulfides and limited sulfur loading. While various polar materials have been investigated to address the issue of polysulfide shuttle, their high density and low specific surface area restrict their ability to achieve substantial sulfur loading. Thus, the strategic design of polar sulfur hosts with large surface areas is vital for the practical realization of Li-S batteries.

In this work, transition metal sulfides are employed as polysulfide immobilizers due to their excellent conductivity and strong affinity for sulfur, enabling efficient polysulfide trapping and conversion. Specifically, sulfide nanoparticles derived from layered double hydroxides (LDHs) are uniformly dispersed on reduced graphene oxide sheets and carbon nanotubes through a simple two-step hydrothermal method. The high surface area of the LDH-carbon composite provides numerous active sites for capturing soluble polysulfides under conditions of high sulfur loading. Furthermore, the binary metal sulfide uniformly distributed within the composite exhibits improved catalytic performance for polysulfide conversion compared to single-component sulfides. As a result, this composite material serves as an effective sulfur host, allowing Li-S batteries to achieve high sulfur loading, leading to exceptional cycling stability and enhanced electrochemical performance.

This research presents a promising approach for realizing high-sulfur-loading Li-S batteries by combining polar and carbon materials, advancing their potential commercialization.

Abstract No. 0217 Thirbika Sathiyamoorthy

A design of cathode materials that are structurally and chemically stable through the ion transfer and charge redistribution during the charge discharge process is a key factor in mobilizing the commercialization of magnesium ion batteries. Additionally, the sluggish kinetics of Mg2+ may affect the cycling performance of a cathode materials and unstable passivating layer in the cathode-electrolyte interphase (CEI) is affecting the Mg2+ ion mobility with the interlayers of cathode. Magnesium metal free anodes can be an alternative that gives a stable CEI, enacting higher possibilities of ion exchange. In this study, V4O10 nanorods were synthesized and to enhance the performance, V4O10 nanorods with reduced graphene oxide composite has been prepared and characterized with XRD, FTIR, Raman, FE-SEM, HR-TEM and XPS analysis. The electrochemical studies were carried out in the potential window of 1.43 V to 3.73 V, using 1M Mg(ClO4)2 in Acetonitrile as electrolyte and activated carbon cloth as anode. The increased s

Abstract No. 0218 pattarapope mungkung

"In this decade, awareness of protecting the earth from climate change is wildly expanding. Therefore, such renewable energy storage technology as batteries and supercapacitors attracts more and more demand. Recently, sodium-ion batteries have drawn much attention as the replacement for lithium-ion batteries, regarding to its abundance that can overcome the cost and the limitation of lithium metal resources. Hard carbon has been a promising anode material for sodium-ion batteries due to a larger interlayer spacing compared to the conventional graphite. Among various types of carbon precursors, biomass as agricultural waste is considered a sustainable carbon source for the hard carbon production. Sorghums are the attractive raw material for producing the hard carbon, since; they can be grown in dry areas and require less water than sugarcane. After harvesting for their gains, a vast amount of the stalk bagasse is left unused or burned for disposal.

Hence, this work was aimed at developing the hard carbon anode material for sodium batteriesfrom the sorghum stalk bagasse. Essentially, the effect of activating agents on the electrochemical performance of the obtained sorghum bagasse derived hard carbon has been investigated. To prepare the hard carbon, initially the dried sorghum bagasse was pretreated by hydrothermally processing within dilute H2SO4 solution at different periods (i.e., 6, 12, 18, and 24 hr). Subsequently, the obtained biochar was carbonized at 950 °C with the various activating agents, as KOH, NaOH, ZnCl2, and CaCl2. Material characterization revealed that most of the sorghum bagasse derived hard carbon showed the multi-scale micro- and meso- porous structure, except the CaCl2 activated hard carbon that expressed the majority of macropore. In consistently at hydrothermal 24 hr, the multiscale porous structure could deliver the large specific surface area of above 1,119 m2.g-1. While high density of the macroporous structure exerted the lower specific surface area of about 45 m2.g-1. All hard carbon products exhibit larger d-spacing compared to graphite, as 0.34, 0.34, 0.41, 0.41 nm for KOH, NaOH, ZnCl2, and CaCl2. Most of the samples exhibited a specific discharge capacity of more than 100 mAh.g-1. Specifically, the CaCl2 activated hard carbon could provide a superior specific discharge capacity of 250 mAh.g-1 at 100 mA.g-1 for 150 cycles and high Coulombic efficiency of more than 98 %."

Abstract No. 0219 Andrew C. Chien

Traditional nitrogen-containing wastewater treatment methods primarily focus on nitrogen elimination rather than recycling in usable form. Degrading ammonia or urea in nitrogen-containing wastewater through fuel cells not only provides electric power generation but also reduces the chemical oxygen demand in the water, thereby minimizing potential environmental pollution. Additionally, both ammonia and urea are easier for storage and transportation with high energy densities, compared with hydrogen. However, the kinetics of low-temperature ammonia and urea oxidation reactions are quite slow, limiting their large-scale commercial application. In the current work, several metal foams were studied as potential anodes for direct ammonia or urea fuel cells (DAFC or DUFC). The modification of these potential anodes were conducted and their electrocataltyic performance were investigated in preliminary studies.

Abstract No. 0220 **Terry Wang**

To meet the growing demands for high-end integrated circuit (IC) packaging, the interconnection of multiple active and/or passive sub-components into a single, complex circuit within a Multi-Chip Module (MCM) package has become a prominent trend focused on enhancing IC performance. To boost efficiency and lower mass production costs, panel-level packaging (PLP) is increasingly favored over wafer-level packaging (WLP). However, two significant challenges remain: fine line redistribution layer (RDL) technology and die shift.

In this study, the Industrial Technology Research Institute (ITRI) has effectively demonstrated the feasibility of this approach through the application of a robust Digital Dynamic Connection (DDC™) technology, utilizing a high-resolution maskless Digital Lithography Tool (DLT). This technology has been shown to successfully provide pattern compensation for fine line RDLs within a chip-first IC packaging framework. In this context, a successful three-layer RDL stack has been accomplished through a panel-level chip-first process, featuring a fine line RDL with a line configuration of 3 μm and a via size of 6 μm. The insights gained from this research are expected to significantly advance the application of Fan-Out Panel Level Packaging (FOPLP) in multi-chip packaging, particularly for high performance chip.

Abstract No. 0221 **Yu-Fan Chen**

Ni-rich layered oxide is considered a promising cathode material of high energy lithium ion batteries due to its high capacity and less Co content. Single crystals of Ni-rich layered oxides are considered superior to polycrystals counterparts due to fewer grain boundaries, which can provide greater stability in electrochemical performance. To obtain single crystal, typically requires calcination temperatures as high as 900°C. Most of synthesis methods for LiNi0.8Co0.1Mn0.1O2 using co-precipitation rather than solid-state method due to smaller particle-sizes and uniform composition.To investigate the effects of different synthesis method, LiNi0.8Co0.1Mn0.1O2 were synthesized by the solid-state and co-precipitation methods at 900°C, respectively. Although the calcination set at the same temperature, the grain size of co-precipitation method is much smaller than that of solid-state one due to the smaller precursor. With smaller grain sizes synthesized by co-precipitation method, a higher discharge capacity (197.17 mAh/g) was observed in the initial cycle at 0.05C. Besides, LiNi0.8Co0.1Mn0.1O2 synthesized by co-precipitation with a grain size about 2-3 μm showed lower cation mixing and better retention after 100 cycles at 0.5C (87.67%).These results demonstrate that single crystals synthesized by co-precipitation method lead to LiNi0.8Co0.1Mn0.1O2 having better electrochemical performance in long-term cycling due to the longer calcination time required for the raw materials, resulting in higher cation mixing.

Abstract No. 0222 Chia-Liang Sun

We started to prepare titanium nanoparticles on nanocarbons for the detection of ractopamine (RAC) since 2022. [1] Furthermore, controlling the sizes of the titanium particles can be achieved by varying the NaOH concentrations in the process after we confirmed using transmission electron microscopy. The electrochemical and photoelectrochemical catalytic activities of the catalysts were measured using cyclic voltammetry. For the solution containing 250 μM RAC, the faradaic current amplification percentage of the optimal catalyst reached 110 % under with purple light (420 nm, 80 mW/cm^2). These results indicate the excellent performance of the catalyst under different light conditions. The strategy with various NaOH concentrations has significant impacts on the preparation and performance of composites.

Abstract No. 0223 Yun Lin

Electrochemical pre-lithiation stands as a practical and widely adopted technique for precisely controlling the degree of pre-lithiation, but the process is usually time-consuming. Herein, we introduce a novel three-stage electrochemical pre-lithiation method, comprising an initial stage of a high current density, a second stage of a low current density, and an additional stage of constant voltage to ensure the complete formation of solid electrolyte interphase (SEI) on the amorphous carbons: soft carbon (SC) and hard carbon (HC). Lithium-ion capacitors (LICs) are configured with the pre-lithiated SC or HC as the negative electrode and activated carbon as the positive electrode to assess the efficacy and adaptability of this three-stage pre-lithiation approach. Our findings demonstrate that this method can reduce the pre-lithiation time from 1114 to 604 min for SC, and from 1913 to 1080 min for HC, achieving nearly 46% and 44% decreases, respectively. Furthermore, the three-stage pre-lithiation method can simultaneously increase reversible Li-ion storage capacity within the same operating potential window, thereby enhancing the electrochemical performance of the LIC cells. Specifically, the LIC cell employing the three-stage pre-lithiated SC exhibits an energy density of 96.5 Wh kg-1 at 0.15 kW kg-1and 76.5 Wh kg-1 at 5.98 kW kg-1. In addition, these cells demonstrate remarkable reversibility, retaining 95.2% charge capacity after 5000 cycles. Similarly, the LIC with the three-stage pre-lithiated HC achieves even higher energy densities of 105.3 Wh kg-1 at 0.15 kW kg-1 and 86.42 Wh kg-1 at 5.98 kW kg-1 with a retention of 85.2% after the same number of cycles. The successful implementation and validation of this three-stage pre-lithiation method pave the way for further development of LICs.

Abstract No. 0224 Yao-Yang Chang

In recent years, the demand for energy storage devices has steadily increased, particularly in renewable energy and electronic products. Various types of energy storage components, including lithium-ion batteries and supercapacitors, have advanced rapidly. Sodium-ion batteries (SIBs) are one of the most promising energy storage devices due to their abundance of materials and low cost. Current research indicates that hard carbon, with its rich structural morphology and large interlayer spacing, is beneficial for sodium-ion storage, making it one of the most promising anode materials for SIBs. Hard carbon can be produced from a variety of precursors, including biomass and polymers. Phenolic resin-derived hard carbon, in particular, is ideal for hard carbon production due to its high carbon yield and stable crosslink structure. This study uses waste phenolic resin as an anode precursor and employs a two-step carbonization process to improve the structure of hard carbon and address these concerns. Changing the pre-carbonization temperature and duration in the first stage had a significant impact on the microporous structure and specific surface area of transition-state carbon species. After pre-carbonization at 650°C for 4 hours, the material had a specific surface area of 505.8 m^2 g-1 and a micropore ratio of 76.9 %. During the second high-temperature carbonization stage (1000°C, 1200°C, and 1400°C), open pores were converted into closed pores, with a closed pore volume of 0.198 cm^3 g-1. This increased the reversible capacity in the low-voltage region (< 0.1 V). The sample carbonized at 1200°C had a high reversible capacity of 302 mAh g-1 and an initial coulombic efficiency of 86 %. These findings indicate that hard carbon derived from waste phenolic resin through a two-step carbonization process can form closed pore-rich structures that are a superior anode candidate for sodium-ion batteries.

Abstract No. 0225 Yu-Chieh Su

As technology advances, the demand for energy storage continues to grow, driven particularly by the rapid development of electric vehicles. The safety and cost-effectiveness of energy storage devices have become critical challenges for the future. It is well known that, compared to lithium metal and lithium-ion batteries, anode-free lithium batteries offer higher energy density and lower costs. However, anode-free lithium batteries face significant drawbacks, such as insufficient charge-discharge cycles and the growth of lithium dendrites. This study aims to use atmospheric plasma to modify three-dimensional metal structures, inhibiting the growth of lithium dendrites while providing more reaction sites than two-dimensional metal structures.

Abstract No. 0226 **Ananya Panda**

High-entropy oxides (HEOs) have emerged as promising anode materials for lithium-ion batteries (LIBs) due to their remarkable lithium storage performance and great cycle life attributed to the entropy-driven stabilization effects, enhanced reaction kinetics, tailorable properties, superior ionic conductivity, and multiple electroactive centers. The effects of morphology on electrochemical properties of HEO anodes have remained unclear until now. In this study, we explore this uncharted territory by developing nanoparticle and core-shell nanosphere HEOs via conventional hydrothermal and microwave-assisted solvothermal methods and conducting a comprehensive analysis of the morphology effects on the electrochemical characteristics of the HEO anodes. The core-shell nanosphere HEO exhibits superior rate performance and cycling stability compared to the nanoparticle HEO counterpart. This enhancement is attributed to the unique core-shell structure, which provides sufficient void space, facilitating electrolyte infiltration and lithium-ion transport while also accommodating HEO volume variation to maintain electrode integrity. These structural advantages result in significantly improved electrochemical properties, demonstrating the potential of morphology engineering in optimizing the HEO-based anode performance. Detailed results and insights into the design of HEOs for advanced LIB applications will be presented in this study.

Abstract No. 0227 **Ching-Yu Chen**

Carbon neutrality has emerged as a global imperative, with numerous nations aiming to achieve this milestone by 2050 or earlier. Utilizing carbon dioxide as a resource presents a promising method toward this goal. Electrochemical reduction of carbon dioxide (CO 2) would be one effective approach to reduce CO 2 emission. In this work, we proposed N-hydroxysuccinimide (NHS) as the organic ligand to react with nickel(II) (Ni(II)) for the synthesis of NiNHS via hydrothermal method.

SEM image (Fig. 1) and FTIR spectrum (Fig. 2) of the as-prepared NiNHS were used to examine its surface morphology and confirm the characteristic bindings, respectively. The FTIR spectrum shows the shift of carbonyl group of NHS which indicates its coordination with Ni(II). Further, pyrolysis of NiNHS in the presence of DCD (dicyandiamide) leads to the formation of N-doped carbon materials. The TEM image of NiNHS after pyrolysis at 900 o C, notated as NiNHS P900, is shown in Fig. 3. It appears to be nodular structure of carbon embedded with nickel particles.

NiNHS P900 was then under investigation of the performance on electrochemical reduction reaction of carbon dioxide. We discovered that the electrodes of 1×1 cm 2 fabricated by the pyrolyzed NiNHS could conduct the reduction reaction of CO 2 for the formation of carbon monoxide (CO). Particularly, among all, NiNHS P900 shows superior performance. To operate at –1.0 V (vs. RHE), a current density of –17 mA cm -2 , could thus be achieved with the Faradaic efficiency for CO of 89% and the CO formation rate of 283 mmol cm -2 h -1 by using an H-cell system.

Additionally, to conduct the reaction in the flow cell system, a current density of –38.6 mA cm -2with the Faradaic efficiency for CO of 97% and CO formation rate of 700 mmol cm -2 h -1 could be obtained under the same operation condition.

Abstract No. 0228 Ko-Fan Tu

Rechargeable zinc-air batteries (ZABs) are promising next-generation energy storage systems due to their high energy density, safety, and cost-effectiveness. However, their performance is limited by the sluggish kinetics of the oxygen reduction reaction (ORR) and oxygen evolution reaction (OER). Noble metals like platinum (Pt) and ruthenium oxide (RuO_2) are effective catalysts but are impractical for large-scale applications due to their high cost and scarcity. Therefore, research has shifted toward non-noble metal catalysts, with transition metal-based materials showing great potential due to their abundance, lower cost, and catalytic activity. Bimetallic layered double hydroxides (LDHs), combining two different transition metals, have emerged as promising OER catalysts due to their large surface area, active sites, and synergistic effects. Nevertheless, conventional LDHs face challenges such as poor electrical conductivity and aggregation during fabrication, reducing catalytic performance and durability.

This study addresses these issues by developing a three-dimensional core-shell catalyst with NiMn-LDH grown on a nitrogen-doped porous carbon (N-C) framework. The N-C framework, synthesized via pyrolysis of zeolitic imidazolate framework (ZIF) materials, offers high nitrogen content, chemical stability, and a large surface area, enhancing ORR activity through abundant catalytic sites. This core-shell catalyst demonstrates strong bifunctional activity for both ORR and OER, effectively enhancing ZAB performance. The improved conductivity and stability address limitations of conventional LDH catalysts, ensuring enhanced durability and efficiency over extended use. This work offers a cost-effective alternative to noble metal catalysts, advancing more efficient and sustainable zinc-air battery technology.

Abstract No. 0229 Hao-Hsuan Hsia

Corrosion protection technology plays a crucial role in preserving infrastructure, ensuring safety, reliability and promoting long-term sustainability. In this study, we combined experiments and density functional theory (DFT) to investigate the mechanism of corrosion for fluorine-doped few-layer graphene (F-FLG). We introduced a facile approach that combines environmentally friendly jet cavitation with hydrothermal processes to synthesize hydrophobic and anti-corrosive F-FLG from graphite (G). By coating F-FLG/epoxy composite film (F-FLG/EP) on the surface of cold-rolled steel (CRS), we found that the addition of F dopant enhanced the hydrophobicity of the F-FLG/EP coating from 78.89◦ to 106.3◦. Notably, the corrosion rate of the F-FLG/EP coating is 8.279 ×10-3 μmpy, which exhibits four orders of magnitude lower than that of the CRS substrate. The DFT calculations indicate an increased band gap for F-FLG. Moreover, the energy barrier for the oxygen diffusion through F-FLG is larger than that for FLG, indicating improved oxygen resistance for F-FLG. These results indicate the high efficiency and potential of F-FLG as a highly promising agent for preventing corrosion in various commercial applications.

Abstract No. 0230 Pinyi Xu

In order to reduce the electrode cost and popularizion of fuel cells, the use of non-precious metal catalysts is the current main focus of research. Among them, Fe-ZIF8 is the most popular catalyst. However, this catalyst has poor stability in acidic electrolytes. In this study, ZIF8 was doped with Fe and Cu atoms and deposited on the surface of reduced graphene oxide (RGO) as a cathode catalyst for fuel cells, to enhance the stability of the Fe-ZIF8 catalyst in acidic electrolytes and its oxygen reduction potential, aiming to replace Pt/C. Experimental results demonstrated that Fe and Cu bimetals can be effectively embedded on the surface of ZIF-8 (this sample is labeled as FeCu-ZIF-8) by using the designed experimental method. The ZIF-8 metal-organic framework containing Fe and Cu bimetals can be effectively deposited on the surface of RGO (this sample is labeled as RGO/FeCu-ZIF-8). The SEM results showed that FeCu-ZIF-8 was uniformly dispersed on the surface of RGO and maintained the complete metal-organic framework structure of ZIF-8. After high-temperature carbonization, the sample (RGO/FeCu-ZIF-8) underwent linear sweep voltammetry (LSV) testing in an acidic electrolyte (0.10M HClO4) at a scanning rate of 50 mVs-1. The results showed that the oxygen reduction half-wave potential (E1/2) of the RGO/FeCu-ZIF-8 sample was 0.841 V, which is approximately 31 mV higher than that of the commercial 40% Pt/C (E1/2: 0.810 V). The results of the 10,000-cycle degradation test showed that the RGO/FeCu-ZIF-8 sample had a potential loss of 14 mV in the acidic electrolyte, which is approximately 9 mV lower than that of Pt/C (23 mV). This sample maintained a current retention rate of up to 91.3% during a 20 hours discharge at a constant voltage (0.60 V) in acidic electrolyte, significantly higher than the 63.4% of Pt/C. Meanwhile, the Tafel slope is 56 mV/dec, with the overpotential being approximately 11 mV/dec lower than that of Pt/C, and the electron transfer number in the oxygen reduction reaction is between 3.98 and 4.00 (@0.30 V - 0.40 V). The presence of RGO effectively enhance the oxygen reduction potential and stability of the Fe-ZIF-8 catalyst in acidic electrolytes, making it highly suitable as a low-cost cathode catalyst for fuel cells.

Abstract No. 0231 ENDALKACHEW ASEFA MOGES

Hydrogen peroxide (H2O2) is a valuable and eco-friendly oxidation chemical used in chemical synthesis, paper bleaching, energy sources, mining, wastewater treatment, and propylene oxide synthesis. We synthesized Pd-N4-CO, Pd-S4-NCO, and Pd-N2O2-C single-atom electrocatalysts using an in-situ synthesis approach involving heteroatom-rich ligands and activated carbon under mild conditions. These catalysts, featuring homoleptic (Pd-N, Pd-S) and heteroleptic (Pd-NO) coordination spheres, show selectivity in the two-electron/four-electron oxygen reduction reaction (ORR). The Pd-N4-CO electrocatalyst excels in reducing O2 to H2O2 via a two-electron transfer in a basic electrolyte, with minimal onset overpotential and >95% selectivity across various potentials. The activity and selectivity for the 2e- ORR follow the sequence Pd-N4-CO > Pd-N2O2-C > Pd-S4-NCO, aligning with the Pull-Push mechanism. Our experimental and DFT findings provide insights into engineering heteroatom-rich ligands to optimize catalytic active sites (Pd-N4), enhancing sustainable H2O2 production.

Abstract No. 0232 Gen Inoue

To increase the charge – discharge rate in batteries or the output power density in fuel cell, microscale electrode structure must be optimized from the viewpoint of effective electrochemical reaction and mass transport. However, it is not easy to do it because we need to understand the mechanism of internal phenomena in these electrodes. Thus, we developed various simulation models with various observation methods and machine learning approaches. In this talk, I will introduce our numerical simulation research.

Abstract No. 0234 Hsiang-Sheng Wei

The instigation of the high-density nanotwinned structure in copper deposits is presently acknowledged as a paramount goal for enhancing the material characteristics of copper. However, the conventional manufacturing processes often involve the incorporation of organic additives, resulting in the consequential impurity effects and aging concerns. In this work, we introduce a high-rate approach to fabricate the (220)-orientation nanotwinned copper foils in a concentrated methanesulfonate copper solution with mere amount of chloride ions as additives. This solution exhibits the plating capability of 60 A dm^-2 (ASD) in the direct current (DC) mode at ambient temperature, giving rise to the formation of numerous twin boundaries inside the copper deposits with average twin spacing meticulously controllable at 30 nm. Moreover, the extent of chloride ion coverage on the cathode surface is posited to be a pivotal determinant of nanotwin formation, particularly under the conditions of relatively high interfacial energy and well crystallinity. This key factor leads to the formation of coordinated ion-complex through the chloride bridge mechanism, thereby boosting the amount of Cu+ intermediates to foster an improved surface conducive to the twin formation process. Moreover, the formation of a nanotwinned structure can reduce the internal residual stress inside the copper deposits through a stress relaxation mechanism. This innovative methodology not only propels our understanding on the nanotwinned copper foils forward but also furnishes a practical and controllable avenue for manufacturing (220)-orientated nanotwinned copper deposits.

Abstract No. 0235 ying-yi chen

In recent years, the focus of research on layered oxide cathodes ($LiMO_2$, M = Ni, Co, Mn, Al) for lithium-ion batteries has increasingly shifted towards nickel-rich variants ([Ni] > 80%). Although the co-precipitation method is widely used commercially for fabrication of these cathodes due to its ability to produce uniform and high-purity materials, it also generates environmentally harmful waste. In contrast, the solid-state reaction method offers a more environmentally friendly alternative for synthesizing Ni-rich cathode materials. In this study, Ni-rich layered cathode materials Li[Ni0.89Co0.05Mn0.05Al0.01]O2 (NCMA89) were synthesized via a solid-state reaction process. X-ray diffraction (XRD) analysis was utilized to monitor the reaction progress and phase transformations from low to high temperatures. The phase evolution and structural changes at various temperatures were systematically studied, and the underlying reaction mechanisms were explored. Additionally, electrochemical testing was conducted using coin cells to evaluate the performance of the NCMA89 material, focusing on capacity retention, cycle stability, and rate capability.

Abstract No. 0236 Keseven Lakshmanan

The electrochemical conversion of CO_2 to ethanol offers a promising solution for reducing CO_2 emissions while producing valuable chemical products. In this work, we introduce NiCu-SACs/N-C catalysts with dual heteroactive sites, achieving the highest catalytic activity for ethanol production to date, with an impressive Faradaic efficiency of 92.2% at a potential of −0.6 V versus RHE. The catalyst also demonstrates a notably low onset potential of −0.4 V versus RHE for CO_2-to-ethanol conversion. In-operando X-ray absorption spectroscopy reveals intriguing restructuring behavior, where dynamically formed Cu clusters evolve from atomically dispersed Cu single-atoms. Moreover, the Cu sites undergo reversible structural or oxidation state changes, while Ni sites remain stable throughout the catalytic reactions. Experimental analysis combined with DFT computations indicates that CO generated on $Cu\text{-}N_4/Ni\text{-}N_3$ cooperative single-atom sites undergoes C-C coupling, which is subsequently reduced to ethanol.

Abstract No. 0237 NINDITA KIRANA

A facile method for preparing hierarchical carbon composites that contain activated carbon (AC), carbon nanospheres (CNSs), and carbon nanotubes (CNTs) for use as the electrode material in supercapacitors (SCs) was developed. The electrochemical properties of the composite carbon electrodes with various thicknesses (~30, ~60, and ~90 μm) are investigated. The CNS/CNT network facilitates the formation of 3D conducting pathways within the highly porous AC matrix, effectively reducing the internal resistance of supercapacitor electrodes. The specific capacitance, cyclability, voltage window, temperature profile during charging/discharging, leakage current, gas evolution, and self-discharge of the fabricated supercapacitors are systematically studied. Electrochemical impedance spectroscopy, postmortem electron microscopy, and X-ray photoelectron spectroscopy analyses are conducted to examine the electrode aging behavior. The hierarchical carbon composite show great potential for practical applications.

Abstract No. 0238 Saravanan Ashok vallal

The metal crosstalk effect from cathode to anode electrodes is well known in oxide cathodes, but in lithium sulfide cathodes, most researchers focus on mitigating the polysulfide shuttle effect.[1] The metal crosstalk effect in lithium-sulfur batteries has not been reported. This is the first study to investigate the metal crosstalk effect in lithium-sulfur batteries. It demonstrates how the migration of catalytic active sites leads to battery decay in Li-S batteries, underscoring the importance of the statement: “Electrocatalysts are worthless without accurate and precise screening.” The development of stable catalytic active sites to accelerate sulfur reduction in Li-S batteries is urgently needed. Therefore, we demonstrate the use of a Nickel single-atom catalyst (Ni SAC) to improve sulfur reduction kinetics and enhance battery cycling performance. Through experiments with commercial molecular NiPc and synthesized Ni-NC catalysts, it was observed that due to the structural instability of NiPc, it migrates from the cathode to the anode (crosstalk effect), loses its centre of symmetry, and forms a new Ni-S bond, leading to battery decay. The incorporation of a Ni single atom on a nitrogen-doped carbon support (Ni-NC) accelerates sulfur reduction and provides a robust catalytic active site, thereby mitigating the crosstalk effect. Significantly, Ni-NC enhances cycling stability, exhibiting a capacity retention of 80% after 300 cycles at 0.5 C, Whereas NiPc experienced a short circuit before 200 Cycles at 0.5C.

Abstract No. 0239 Kuan-Ling Liu

"It is established that different manufacturing processes yield nanotwinned copper with varying properties, such as distinct crystal orientations, nanotwin densities, and average twin spacings. Although the literature extensively covers the control of crystal orientation and nanotwin density in nanotwinned copper, there remains a limitation in controlling average twin spacing. Recently, it has been demonstrated that by adjusting the duty ratio (γ) and the pulse frequency (f) in the pulse electroplating deposition (PED) mode—specifically, the duty ratio refers to the ratio of on-time to the sum of on-time and off-time —it is possible to alter the average twin spacing, where a lower γ and a higher f result in smaller twin spacings. However, the control of twin spacing in direct current (DC) mode remains insufficient, particularly considering that the future Cu pillar plating processes for wafer packaging are anticipated to employ current densities up to 400 $\mathrm{mA \cdot cm^{-2}}$ under DC mode. Furthermore, variations in average twin spacing significantly influence the properties of nanotwinned copper. Studies have demonstrated that different twin spacings result in varying ultimate tensile strength, fracture elongation, and chemical corrosion resistance. Therefore, optimizing direct current (DC) electroplating parameters to regulate twin spacings within copper at high plating speeds is expected to be a critical step forward in advancing future industrial applications. Herein, a novel approach to controlling the average twin spacing of (111)-oriented nanotwinned copper deposits has been developed by adjusting the aeration flow rate within the electroplating bath. This alteration affects the activity of convection-sensitive additives, notably 3-mercapto-1-propanesulfonate (MPS), allowing for twin spacing to be regulated between 61.37 nm and 136 nm at an electroplating rate of 400 $\mathrm{mA/cm^2}$, which is sufficiently high for commercial utilization. Additionally, thorough electrochemical analysis enhances our understanding of the nanotwin formation mechanism in copper and sheds light on the relationship between mass transfer dynamics and additive effects."

Abstract No. 0240 **Yu-Chun Huang**

As the demand for cost-effective and safe energy storage solutions grows, scientists are actively seeking alternatives for next-generation rechargeable batteries using abundant elements. Sodium-ion batteries (SIBs) have emerged as a promising candidate due to their similar chemistry to lithium-ion batteries (LIBs)[1], but challenges such as lower energy density and limited cycle life have restricted their broader application. This study presents a novel hybrid Li/Na-ion battery, utilizing a lithium vanadium fluorophosphate (LiVPO4F) cathode, aluminum foil as a current collector because alloys between Na and Al cannot be formed in the voltage range between 0.0 and 5.0 V, and a sodium-based electrolyte. This innovative design, employing a commercial Li cathode, reduces development costs by eliminating the need for further investment in cathode material manufacturing. The hybrid system, which contains both lithium and sodium ions, leverages the fast ion diffusion properties of monovalent ions and the high capacity of multivalent ions. Sodium ions preferentially form a sodium-rich solid electrolyte interphase (SEI), while a Li+ electrostatic shield suppresses uneven sodium metal deposition.[2]

The assembled hybrid Li/Na battery system exhibits two high working voltages at about 4.01 and 3.76 V with a capacity of 156 mAh/g. To visualize the plating/stripping processes, an in-situ Electrochemical Reaction Visualizing Confocal System (ECCS) was used for observation.Using X-ray diffraction (XRD) tests were implemented to analyze the reaction kinetics and mechanism of the LiVPO4F electrode during the Li+ de-/intercalation processes. To better understand the formation of SEI on the current collector, surface composition evaluation was done on X-ray photoelectron spectroscopy (XPS). This work provides a new design to develop advanced hybrid batteries and demonstrates its feasibility in practical applications.

Abstract No. 0241 **Yo-Yuan Gu**

With increasing awareness of disease prevention, the early detection of symptoms through metabolic monitoring has gained significant interest. Hydrogen peroxide (H_2O_2), a key reactive oxygen species, plays a critical role in the development of various diseases. As a result, advancements in H_2O_2 sensing technologies are crucial for improving tools for early disease prevention and management.

This study focuses on iridium oxide (IrOx) as a core material, selected for its biocompatibility and high stability. Two fabrication techniques were utilized to create IrOx electrodes. The first method combined electrospinning with thermal treatment to develop hollow, nanofiber-structured IrOx. The second method involved direct electrospinning of keratin. Additionally, magnetron sputtering was employed to deposit iridium onto the substrate's surface. Electrochemical analyses were then conducted to explore the differences in the material properties arising from these fabrication techniques.

This research examines the microstructure and composition of IrOx nanofibers, with the objective of identifying the optimal Ir/IrO_2 ratio and parameters for enhancing electrochemical performance. The study compares electrodes fabricated using different methods, evaluates their charge storage capacity via cyclic voltammetry, and assesses their sensitivity to H_2O_2. Furthermore, the advantages and limitations of various bonding techniques are discussed to provide insights for future applications.

Abstract No. 0242 卓薰雅

Sodium-ion batteries (SIBs) have been recognized as the next-generation batteries due to their comparable cell configuration and working mechanism. The advantages of SIBs contain earth abundant sodium resources and good performance based on the development of layered oxide cathode. However, sodium-ion batteries encounter several challenges, including sensitivity to humid environment, irreversible phase transformation during charge-discharge cycling and complex charge-compensation mechanism which affect their overall performance.

In this study, Mn-based NaxTMO2 layered oxide, namely NaxMnO2 with affordability and ecofriendliness is used as the cathode material. The objectives of this work are (1) to synthesize NaxMnO2 through the solid-state reaction, (2) to analyze the reaction between precursors, (3) to observe and understand the structural evolution, (4) to investigate dependence of the electrical conductivity upon the chemical composition and/or crystal structure based on defect chemistry consideration.

Abstract No. 0243 Chih-Liang Wang

Lithium metal is considered an ideal anode material for lithium-ion batteries due to its high theoretical capacity (3860 mAh/g) and low electrochemical potential (-3.04 V vs. standard hydrogen electrode). However, its practical application faces challenges such as lithium dendrite formation, volume expansion, and dead lithium, which hinder performance. To address these issues, this study utilized atomic layer deposition (ALD) of zinc oxide (ZnO) on electrospun carbon nanofibers (CNFs) to develop a high-performance, three-dimensional (3D) lithium metal composite anode. Polyacrylonitrile (PAN) was first electrospun to create the carbon nanofiber (CNF) framework. The lithiophilic properties of CNFs were systematically investigated by varying the number of ALD ZnO cycles. The 3D lithium metal composite anodes were then formed by infusing molten lithium into the ZnO-coated CNFs. These composite electrodes demonstrated excellent electrochemical performance, with a low overpotential and a prolong cycle life in symmetric cell tests. In full-cell tests with LiFePO4, the 3D Li composite anode achieved a better capacity than the Li metal foil. Overall, the combination of electrospinning and ALD technology shows significant promise in developing 3D lithium metal composite electrodes that improve lithium diffusion and current distribution as well as enhance battery stability, cycle life, and rate performance.

Abstract No. 0244 Zong-Min Yang

As more renewable energy is utilized, there is a growing demand for long-duration energy storage. The vanadium redox flow battery (VRFB) has the potential of long-term energy storage because it is safe, long cycle life, and flexible design on power-to-energy ratio. The VRFB system uses pump to circulate the electrolyte between the storage tank and the stack during charging and discharging process. The flow rate of the electrolyte affects the transfer phenomenon of vanadium ions in the cell, which affects the cell performance. In this study, the concentration profiles inside the VRFB cell with different lengths of flow channels at the same flow rate were calculated as shown on Fig.1. The results show that the polarization due to vanadium electrolyte concentration variation increases with the length of the flow channel. This mass transfer phenomenon causes the concentration polarization to become more serious for VRFB system, when it is scaling up from laboratory scale to commercial scale. Reducing the concentration variation of vanadium electrolyte is one way to improve the performance of VRFB.

Abstract No. 0245 Bing Joe Hwang

Lithium ion/metal batteries with liquid electrolytes still have leakage and flammability related safety concerns. Since solid-state electrolytes are in the absence of leakage and flammability issues, all-solid-state lithium metal batteries (ASSLMBs) can eliminate safety concerns. However, adopting ASSLMBs with current knowledge and development is challenging or impractical. Unlike liquid electrolytes, solid electrolytes are rigid and less capable of conforming to the electrode surfaces, often leading to high interfacial resistance. Enormous challenges exist due to various irreversible phenomena and air instability in ASSLMBs. Our group has developed several new solid electrolytes to mitigate those irreversible interfacial phenomena and air instability issues. The recent progress of sulfide based ASSLMBs in Sustainable Electrochemical Energy Development (SEED) Center will be presented. The scalability and performance of the developed electrolytes and corresponding ASSLMBs will be also reported.

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Abstract No. 0246 **Bushra Rehman**

Efficient hydrogen generation is vital for the hydrogen economy. Two-dimensional heterostructures enhance electrocatalytic activity and active site exposure for the hydrogen evolution reaction. We introduced a low-temperature plasma-assisted method to create a stable 1T-WS2/1T-WSe2 heterostructure, exhibiting exceptional electrocatalytic performance. Here in this study, we explore the fabrication and characterization of a novel 3D WS_2/WSe_2 heterostructure designed for enhanced Surface-Enhanced Raman Scattering (SERS) and hydrogen evolution reaction (HER) applications. Leveraging the unique properties of both tungsten disulfide (WS_2) and tungsten diselenide (WSe_2), the heterostructure is synthesized through a controlled low-temperature process, ensuring optimal integration and interface quality. The resulting 3D architecture significantly increases the active surface area, promoting efficient charge transfer and enhancing electromagnetic field localization. Comprehensive SERS measurements reveal remarkable sensitivity, enabling the detection of low-concentration analytes with high specificity, attributed to the synergistic effect of the heterostructured morphology and the plasmonic characteristics of the interface. Additionally, electrochemical tests demonstrate superior HER performance, showcasing enhanced catalytic activity and stability compared to monolayer counterparts. The findings indicate that the 3D WS_2/WSe_2 heterostructure serves as a promising platform for multifunctional applications in sensing and energy conversion, paving the way for future advancements in nanomaterial engineering and device design.

Abstract No. 0247 Shun-Jhih Yang

"Poly(ethylene oxide) (PEO)-based solid electrolytes have emerged as propitious candidates in the pursuit of all-solid-state lithium-ion batteries. Although polymer electrolytes possess advantages such as good electrochemical stability toward lithium metal, commensurate mechanical properties and convenient fabrication method, they still encounter some critical issues which are necessary to be tackled when it comes to their practical applications; for example, lithium dendrite formation and relatively low ionic conductivity. To efficiently solve these problems, it is essential to elucidate the ionic transport properties in solid electrolytes.

Herein, we report the anisotropic ionic transport behavior in PEO-based electrolytes and show how different configurations for cell assembly dictate their ionic transport properties. A novel pouch cell design, combined with an electrochemical methodology utilizing impedance spectroscopy and steady-state polarization, was developed to measure both the ionic conductivity and cationic transference number within the same PEO film. The polarized optical microscopic (POM) images are presented as well to delineate the amorphous and crystalline domains of PEO under certain temperatures. To enhance the completeness of theoretical explanations, we conducted finite-element simulations based on POM results for electrochemical analysis. We observe that the cationic transference number are much higher in the in-plane configuration than in the through-plane one, a phenomenon that has not been previously reported in the literature.

In summary, high cationic transference numbers can circumvent uneven cation distribution, thus attenuating the polarization, formation of lithium dendrites and undesirable side reactions. By applying our approach to the size engineering of polymeric spherulites and optimizing film thickness, the lithium-ion transference number can be significantly enhanced, which is highly advantageous for the application of polymer electrolytes in next-generation all-solid-state lithium-ion batteries."

Abstract No. 0248 Ngoc Thanh Thuy Tran

Copper indium gallium selenide (CIGS) solar cells have gained significant global attention in recent years due to their high conversion efficiency, reaching up to 23.35%. To further enhance this efficiency, optimizing the band offsets at heterointerfaces via doping is crucial, as these offsets directly influence charge carrier separation and transport, ultimately determining the overall performance of the device. This study employs first-principles calculations to investigate the fundamental properties of the complex senary compound AgzCu1-zIn1-xGax(Se1-ySy)2 (ACIGSeS) and its band offsets with the cadmium sulfide (CdS) buffer layer. The results reveal that compositional variations significantly impact the heterojunction band offset, with the x and y ratios primarily affecting the conduction band offset, while the y and z ratios govern the valence band offset. By carefully controlling the x, y, and z values, the barrier heights at the interface can be effectively reduced, improving cell efficiency. These findings provide valuable reference data on band offsets and offer guidance for experimental researchers in optimizing the compositions of CIGS-based photovoltaic cells. Moreover, they lay a theoretical foundation for designing more efficient photovoltaic devices.

Abstract No. 0249 **Ray-Rong Tang**

To meet the strict safety, energy density, and power density requirements of consumer electronics like smartphones, laptops, and electric vehicles, it's essential to increase the amount of active materials compared to non-active components such as binders and conductive agents. This allows for a higher proportion of active materials. [1]

Electrophoretic deposition (EPD) is a specialized technique where charged particles in a solution are attracted to and deposited onto a substrate under an electric field. In this study, nickel-rich layered oxide LiNi0.8Co0.15Al0.05O2 (NCA) is prepared with a small amount of binder and conductive agent. By applying a 60V electric field, NCA particles are deposited onto an aluminum foil, forming a layer approximately 20μm thick. After drying, this NCA-coated aluminum foil is ready for further analysis. The study will examine the different morphologies and microstructures of NCA films processed under various voltages and durations, and analyze their properties in terms of electron and ion transport, [2] as well as charge-discharge performance.

Abstract No. 0250 **LI-AN KUO**

The current modification methods for silicon nanowire (SiNW) anode in lithium-ion batteries primarily include p-type or n-type doping, carbon materials, metallic materials, metal oxides, and polymers composited with SiNW anode. However, there are few studies or papers on transition metal dichalcogenide (TMD) materials composited with SiNWs. In this work, MoS2 composited with highly doped n-type SiNW represents a dual modification approach. I choose highly doped n-type (0.001-0.005Ω*cm) which possesses excellent fast charge-discharge characteristics and rate performance to form SiNW by the MACE (Metal Assisted Chemical Etching) process. We aim to modify the surface of SiNW with MoS2, which exhibits good rate performance and lower cycling degradation. Introducing MoS2 with the SiNWs anode also help suppress its volume expansion. In the first method, we expect to see better fast charge-discharge characteristics and rate performance than what Chen etal. did. In the second method, we hope to form free-standing anode better than what Andika Pandu Nugroho etal. did.

Abstract No. 0251 Kuan-Zong Fung

"Recently, Ni-rich layered oxide cathodes have been classified by the sizes of their grains, namely “single-crystals” and “polycrystals”. Although such a definition has been widely used in the battery community, it seems too simplified that the performance of oxide cathode is determined by its morphology only. In this study, the grain-growth, crystallization, defect reaction of Ni-rich layered oxides during high-temperature synthesis will be discussed. Accordingly, the structural, microstructural and electrical properties of decomposed precursors and resultant layered oxides will be examined during the different stages of processing. During the different stages of processing, the structural, microstructural and electrical properties of decomposed precursors and resultant layered oxides will be examined using XRD, SEM and DC/AC impedance measurements. CV and charge/discharge tests from assembled coin cells will be used to evaluate electrochemical properties of Ni-rich layered oxides. It is expected that Ni-rich layered oxides with improved performance will be obtained through an optimized process.
Furthermore, to design electrodes with high areal loading is necessary in order to increase the energy content of battery effectively. With high areal loading, there will be benefits of using less current collectors, separators, and packaging components. Thus, the enhancement in energy density and the reduction in fabrication cost may be possible. In this study, 3D conductive scaffold was first adopted for the preparation of thick cathode (~200 m). With the adoption of 3D porous metallic foam as a scaffolding foundation, a novel deposition method, namely electrophoretic deposition (EPD), was selected for the preparation of thick Ni-rich NMC cathode. In comparison to conventional slurry coating method, EPD-deposited Ni-rich NMC cathode with 3D porous metallic foam does not only show a comparable specific capacity as high as 130 mAh/g at 1C rate but also provide areal loading of 20 mg/cm2 and areal capacity of 3.5 mAh/cm2."

Abstract No. 0252 Ting-Jang Tsai

The adoption of electric vehicles is hindered by the limitations in fast-charging capabilities and energy density of lithium-ion batteries (LIBs). Silicon-based anodes are promising for next-generation LIBs, offering high theoretical capacity, faster reaction kinetics, and improved lithium-ion diffusion. However, their practical use is constrained by significant volume changes during lithiation and delithiation, coupled with poor intrinsic electrical conductivity, which degrade cycle stability. In this study, we examine the potential of silicene flowers (SFs) as fast-charging anode materials. SFs features a unique 3D flower-like structure made of interconnected silicene nanoplates oriented in various directions, providing superior accommodation for silicon's volume fluctuations and shorter lithium-ion diffusion paths. To further address the issue of volume expansion, we introduce a protective layer of nickel-manganese (Ni-Mn) oxides. These oxides not only manage expansion but also deliver high theoretical capacity, excellent reversibility, and strong rate performance. To enhance electron mobility, we integrate reduced graphene oxide (rGO), which also provides space to buffer particle expansion. The Ni-Mn oxide layer acts as a barrier between the silicon and rGO, preventing the formation of Li2SiF6, a harmful byproduct of side reactions often catalyzed by carbon materials. This composite anode material is synthesized through a non-toxic, environmentally friendly process, offering both cost-efficiency and sustainability. Our work introduces a promising approach for fast-charging anodes with improved rate performance, further advancing the development of safer, high-energy density LIBs for future applications.

Abstract No. 0253 Chia-Hung Yeh

The vanadium redox flow battery (VRFB) has great potential for energy storage application because it is safe, reliable, and long cycle life. However, high installation cost of VRFB electrolyte limit its application. Production of vanadium electrolyte from V2O5 with low iron impurty is difficult. It is important to produce high-quality vanadium electrolyte at low manufacturing cost. This study measured the solubility of iron ions in different acidic vanadium solutions. We also synthesized V2O5/IrCl3 catalysts by hydrothermal methods. It lower the OER (oxygen evolution reaction) overpotential and increase the electrode lifespan. Experimental results showed that electrolyte with pH less than 1 was suitable to separate the iron from vanadium electrolyte. The XRD (X-ray diffraction) results showed that V2O5/IrCl3 was successfully synthesized on the MOF-V (vanadium-based metal organic frameworks). The RDE (rotating disk electorde) results demonstrated a reduction in the OER overpotential.

Abstract No. 0254 Afif Thufail

Silicon suboxide (SiOx x~1) appears particularly promising strategies for application due to its relative high capacity (~1500 mAh g-1), lower volume expansion (~200), and low cost. Moreover, it maintains the volume change in long-term cycles can be buffered by the irreversible reaction of lithium oxide (Li2O), and lithium silicate (Li4SiO4) during the initial lithiation. However, the losses of Li+ according to the irreversible reaction leads to the low initial coulombic efficiency (ICE). In order to compensate for the consumption of the active Li+, additional active Li+ into SiOx anode in advance is one of the reliable methods to overcome this issue, named as prelithiation techniques. In this work, we aim to find a method for the surface coating layer which has a good stability and high-lithium conductive. Therefore, we proposed a simple surface prelithiation strategy to construct organic-lithiated coating layer on the SiO surface. The results of electrochemical performance, such as the impedance spectroscopy, rate performance, and cyclability tests, demonstrated the modified by using surface prelithiated significantly improved the battery performance. X-ray photoelectron spectroscopy (XPS) indicated high LiF formation, affect to the lower of diffusion barrier of Li+ and high shear modulus, which beneficial to improved electrochemical performance. This research confirms that the surface prelithiation affect to the remarkable of SiO anodes, which improvement in the energy density and excellent rate performance.

Abstract No. 0255 Hsiharng Yang

Hydrogen energy plays a key role in the implementation of zero carbon emission. Ammonia with advantages of storage and transportation mobility are noticed particularly for power generation [1, 2]. This report will examine several key variables that directly impact the performance of low-temperature direct ammonia fuel cells (DAFC) using a cross-comparison method to achieve optimal test parameter settings. Additionally, the study explores the use of non-precious metal catalysts instead of traditional platinum catalysts at the cathode, aiming to reduce costs while maintaining high power density. For the cathode catalyst, iron (Fe) and copper (Cu) were tested on different carbon carriers, and the successful preparation of the FeCuN/C electrocatalyst was verified through SEM, EDS, and XRD analyses. The electrochemical results from cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) indicated that FeCuN/C exhibited more distinct redox peaks and the lowest impedance of 22.15Ω. At the anode, 40wt% PtIr/C was selected for its proven high efficiency and stability. The power density of the AEM-DAFC was measured in a mixed solution of ammonia (NH3) and potassium hydroxide (KOH) under O2, achieving a maximum power density of 269 mW/cm^2 at a working temperature of 110°C and a catalyst load of 2 mg/cm^2 for FeCuN/C. To improve the power density, Pd and Co were introduced, resulting in the synthesis of a novel 15wt% PdAgCo/C cathode catalyst, which increased the power density to 74 mW/cm^2. Ultimately, by adjusting the loading of both the anode and cathode to 2 mg/cm^2, the power density reached a maximum of 332 mW/cm^2. This study demonstrates that higher peak currents and lower impedance correlate with better power density. It can implement to use ammonia as a fuel for DAFC.

Abstract No. 0256 Bereket Woldegbreal Taklu

Utilizing the "Holy Grail" lithium metal anode is crucial for attaining high energy density. Nevertheless, employing a lithium metal as anode faced practical challenges due to thermodynamic instability and dendrite growth1. An artificial stabilization of Li metal mainly employed to mitigate the electrolyte decomposition, dead lithium metal formation and dendrite growth2. A facile and cost-effective gas treatment of lithium metal was carried out using thermal pyrolysis of NH4F salt to generate HF(g) and NH3(g). An exposure of lithium metal to the generated gas induces a spontaneous reaction that forms multilayer protection with multiple solid electrolyte interface (SEI) components, such as LiF, Li3N, Li2NH, LiNH2, and LiH from a single salt. The artificial multilayer protection on lithium sustains stable lithium reversibility; suppress lithium dendrite and overpotential under varied cell configuration both symmetric, Li||Li and half-cells, Li||Cu and Li||MCMB systems. We demonstrate that the desirable protective layer with LiFePO4 (LFP) showed a capacity retention (CR) of 90.6% at 0.5 mA cm−2 after 280 cycles, and LiNi0.5Mn0.3Co0.2O2 (NCM523) showed 58.7% at 3 mAcm−2 after 410 cycles. Formulating the multi-layered protection, with the simultaneous formation of multiple SEI components in a facile and cost-effective approach from NH4F as a single salt, making the system competent.

Abstract No. 0257 **Shao-Sian Li**

Ammonia, as a non-carbon fuel, is increasingly in demand due to global population growth. Traditional ammonia production via the Haber-Bosch process is energy-intensive, requiring high temperatures and pressures, which lead to significant carbon dioxide emissions. This study presents a sustainable alternative through bias-free photoelectrochemical (PEC) nitrogen reduction reaction (NRR) to realize artificial photosynthesis of solar to ammonia conversion, utilizing a perovskite-silicon tandem absorber integrated with a 1T-MoS2 catalyst. The experimental result demonstrates a promising solar-to-ammonia conversion efficiency of 1.63% (0.5 M Li2SO4 electrolyte) under one sun illumination (100 mW/cm^2, AM 1.5G) without external bias, achieving bias-free artificial photosynthesis of ammonia. This device configuration shows the promising direct solar to ammonia conversion and leverages cost-effective and abundant materials, offering a viable solution for large-scale ammonia synthesis. The success of this system underscores the potential of utilizing renewable solar energy for sustainable chemical production, marking a significant advancement in the field of solar-to-fuel conversion and opening new avenues for environmentally friendly ammonia synthesis.

Abstract No. 0258 **Chang-Ming Jiang**

Photoelectrocatalysis stands at the forefront of transformative advancements in the chemical industry, offering a path toward a more sustainable future. Beyond water splitting and carbon dioxide reduction, photoelectrocatalysis has expanded into biomass upgrading and synthetic chemistry over the past decade. Semiconducting photoelectrodes enable redox reactions at interfaces with electrolytes, reducing energy demands and eliminating the need for toxic or costly homogeneous catalysts. This talk highlights two key photocatalytic organic transformations. First, we demonstrate the selective oxidation of benzyl alcohol to benzaldehyde using a bismuth vanadate (BiVO4) photoanode in acetonitrile, effectively avoiding benzoic acid formation. Our study uncovered the emergence of surface states formed between BiVO4 and the redox mediator, N-hydroxy-succinimide (NHS), leading to a gradual decline in photocurrent density. Using electrochemical impedance spectroscopy and intensity-modulated photocurrent spectroscopy, we probed carrier dynamics and found that NHS radical adsorption facilitates charge recombination. We propose optimized deposition methods and dopant incorporation to suppress these detrimental surface states. In a separate study, we tailored inverse spinel CuFe2O4 from n-type to p-type by tunning annealing temperature and atmosphere. By passivating oxygen vacancy donors and creating copper vacancy acceptors, we optimized the system for photocatalytic hydrogenation of benzaldehyde to benzyl alcohol, maintaining operational stability for over 16 hours. We further analyzed the influences of electrolytes and trace water impurities on the reduction reaction. Our findings underscore the importance of understanding the chemical and dynamic landscapes at the semiconductor-electrolyte junction to harness the full potential of photoelectrocatalysis, advancing molecular transformations with unique product selectivity.

Abstract No. 0259 Cheng-Lan Lin

This study presents two innovative approaches to enhance electrochromic devices (ECDs): employing micropatterned thin films and integrating ultraviolet-cured (UVc) electrolytes with in-situ polymerization (ISP). Micropatterned Prussian Blue (PB) and poly(3,4-ethylenedioxythiophene) (PEDOT) films were fabricated using electrostatic field-assisted potentiostatic electrodeposition and assembled into complementary ECDs. Compared to conventional films, these micropatterned films significantly improved electrochromic properties, including faster response times and enhanced long-term stability. ECDs with double-sided micropatterned films showed reduced coloring and bleaching times by approximately 29% and 11%, respectively, without compromising transmittance modulation (ΔT) and maintained about 70% of their initial ΔT after 11,500 cycles. In the second approach, PEDOT films were deposited on indium tin oxide (ITO) glass, and ECDs were assembled using UV-cured electrolytes combined with ISP. Electrolyte solutions containing EDOT monomers were UV-cured under optimized conditions, forming solid electrolytes while generating PEDOT films in situ. Optimal parameters yielded significant improvements in ΔT, rapid coloring and bleaching times, and high coloration efficiency, with minimal ΔT decrease after 1,000 cycles. Spectroscopic and microscopic analyses confirmed the favorable properties of the cured electrolytes. These findings demonstrate that employing micropatterned thin films and UV-cured electrolytes with ISP significantly enhances ECD performance, offering practical strategies for developing high-performance electrochromic devices with faster response times, more outstanding durability, and improved coloration efficiency.

Abstract No. 0260 Nae-Lih Wu

All-solid-state lithium-ion batteries (ASSLIBs) have been considered suitable alternatives to commercial lithium-ion batteries (LIBs) in the aspect of safety issues that come from the use of inflammable solid electrolytes to replace organic flammable electrolytes. Nevertheless, there remains much room for a better understanding of their properties and behaviors to upgrade their performance to reach the practical application level. Ni-rich layered oxides, LiNi1-x-yCoxMnyO2 (NCM), are promising cathodes for high-energy ASSLIBs because of their high capacities and redox potentials, and low material cost when compared with conventional LiCoO2. However, certain challenges associated with their use in ASSLIBs must be addressed for their effective use and industrialization. This presentation reports measurements taken to resolve the issues associated with composite cathode consisting of Ni-rich (Ni content>=83%) NCM and brittle Li3InCl6 (LIC) solid electrolyte (SE) in terms of interfacial mechanical and chemical stabilities.

Abstract No. 0261 Chun-Ting Li

Polymeric chalcogenides, including [Cu2(6mna)(6mn)NH4]n-NO3, [Co2(6mna)2]n-NO3, [Co2(6mna)2]n-Cl, [Cu/Co(6mna)2]n-NO3, [Cu/Co(6mna)2]n-Cl (6mna= 6-mercaptonicotinic acid; 6mn= 6-mercaptonicotinate), silver bezeneselenolate ([Ag2(SePh)2]n; mithrene), and PEDOT-PEDTT (PEDOT= poly(3,4-ethylenedioxythiophene); PEDTT= poly(3,4-ethylenedithiothiophene)), were newly introduced as the electro-catalysts for the counter electrodes in dye-sensitized solar cells (DSSCs).[1-2] By using a ligand-assisted hydrothermal method, a metal-assisted hydrothermal method, or an electro-deposition method to achieve the bottom-up film growth, all the polymeric chalcogenides films were covalently bonded to a conducting substrate of carbon cloth (CC) to deliver their intrinsic electro-catalytic ability without any additives. In an I−/I3− electrolyte, the DSSCs coupled with all the CC/(Cu/Co)-MOF electrodes showed a superior solar-to-electricity conversion efficiency (9.4%~10.0%) than the cell with the traditional CC/Pt electrode (9.3%), demonstrating their outstanding electrochemical activities. In a [Cu(dmp)2]2+/1+ (dmp= 2,9-dimethyl-1,10-phenanthroline) electrolyte, the DSSCs coupled with the CC/AgSePh-30 (10.2%) and CC/PEDTT-50 (10.4%) electrodes both outperformed the CC/Pt electrode (7.43%), indicating the significant of inserting electron-donating S/Se atoms for increasing defects/active sites, adjuting a suitable energy band structure, and creating low-dimensional charge transfer routes. This work shed the light on the future design and synthesis in Cu-complex (or iodide) mediators and functional polymeric chalcogenides for high-performance DSSCs.

Abstract No. 0262 Chi-Jyun Ko

"The operation of lithium-ion batteries involves complex electrochemical processes. Traditionally, understanding the internal reaction states of a battery requires invasive experiments to measure various parameters. However, these methods necessitate expensive equipment and result in damage to the battery, limiting their practical application. In recent years, non-destructive testing methods have become a popular research topic. By measuring battery signals—such as voltage or current—and utilizing electrochemical models to simulate the battery, it is possible to estimate the internal electrochemical mechanisms without causing damage, enabling electrochemical analysis in practical applications [1].

However, due to the numerous electrochemical parameters, not all strongly correlate with the measured battery signals. This means that not every electrochemical parameter can be obtained through this method. Sensitivity analysis can be employed to understand the correlation between measured signals and electrochemical parameters. In this research, we perform both local and global sensitivity analyses to investigate the relationships between electrochemical parameters and measured battery signals, thereby categorizing the electrochemical parameters. Among the battery's measured signals, we chose Electrochemical Impedance Spectroscopy (EIS) as our focus because EIS is rich in battery information [2], and each frequency band corresponds to different electrochemical reactions. Through this research, we aim to understand the associations between different frequency bands and electrochemical parameters, providing a reference for future parameter identification."

Abstract No. 0263 Byungchan Han

The performance of electrochemical systems exposed to electrochemical reactions is critically controlled by how to design highly functional materials. For example, solid electrolytes are key component for the next-generation lithium-ion batteries due to its chemical stability far better than liquid-phase counterparts. But its lower ionic conductivity has kept delaying a commercialization. On the other hand, in electrochemical conversion reaction the crucial component is electrocatalysts, which is typically fabricated as small powders or nanoparticles supported by carbon-based materials. Till now no electrocatalysts have been identified satisfying three criteria: activity, selectivity and stability in addition to cost effectiveness.

In this presentation, it is demonstrated that a self-driving computational strategy for exploring highly functional materials empowering performances of electrochemical energy storage and conversion systems. Combined with DFT calculations and kinetic models with input by thermodynamic formalisms we utilized machine learning techniques to explore various candidates for the target and to understand fundamental mechanisms of the reactions. Specifically, an equivariant graph neural network (GNN) as a surrogate model was used to predict DFT labels directly from the atomic structure. The chemical environments learned by the GNN lead to capturing composition-structure-property relationships for the electrochemical reactions. In addition, we developed an active learning for facilitating the investigation of the search space by balancing the exploration of unseen atomic structures with the exploitation of the active ones. Our approach shows that materials, consisting of multi-element, so called high entropic materials can be designed for targeting performances.

Abstract No. 0264 Yan-Heng Wu

Separators are key components in lithium-ion batteries, serving as a barrier between the cathode and anode while facilitating the exchange of ions. The properties of these porous polymer films affect battery safety, capacity, and longevity. In addition to being electrically insulating, they must have good thermal, chemical, and mechanical stability. In this work, the comparative analysis of various separators, including Celgard 2325, W2091, A2091-BB, and W2091-BB are discussed.

First, the mechanical stability, indentation test, and tensile test were carried out to understand the strength, hardness, and Young's coefficient of the various separators in different directions [1]. Those properties can predict the life of the battery. Meanwhile, a comparative analysis of thermal stability, heat shrinkage test, and thermogravimetric analysis was performed to understand the deformation and shrinkage rate of the separator and the heat resistance of the material under thermal runaway conditions, which is important to understand whether the separator is safe in the event of thermal runaway of the battery. The results show that the A2091-BB separator has comprehensive advantages in terms of mechanical stability and thermal stability.

Abstract No. 0265 Su Ching Yuan

Lithium metal batteries (LMBs) face significant challenges, including dendrite growth and degradation during cycling. Two effective strategies to address these issues involve utilizing a nano-structured current collector as a lithium host and forming an artificial solid-electrolyte interphase (ASEI) layer. However, synthesizing an anode modifier that offers high cycling stability and efficient lithium diffusion/storage via a well-controlled deposition method remains challenging. This study presents a novel gradient composite ASEI layer comprising fluorinated graphene (FECG) and intrinsic graphene (ECG), deposited through electrophoretic deposition (EPD). The gradient structure provides separate ionic and electronic transport pathways. The top FECG layer enhances lithium ion diffusion for uniform plating, while the underlying ECG layer facilitates efficient electron transfer. A thin FECG layer at the base ensures strong adhesion to the copper substrate, enabling stable lithium deposition and improved structural integrity. The composite ASEI membrane demonstrates outstanding electrochemical performance, showing a low nucleation overpotential of 46.1 mV and stable polarization over 600 hours. After 325 cycles, the Coulombic efficiency reached 97.2%, indicating excellent stability. In full-cell testing, the specific capacity exceeded 120 mAh/g after 150 cycles, with 72% capacity retention after 160 cycles. Overall, this innovative composite multilayer ASEI offers a promising solution to overcome the challenges of anode-free lithium metal batteries (AFLB), paving the way for safer and higher-energy-density battery technologies.

Abstract No. 0266 Zabish Bilew

Conventional Celgard 2325 separators, commonly used in lithium rechargeable batteries, face challenges like poor dimensional flexibility, electrolyte affinity, and thermal instability, leading to internal short circuits and thermal runaway. To address these challenges, we developed novel 3D cross-linked and thermally stable fluorinated polyimide (FPI)/PVDF-HFP (PV) hybrid nanofiber separator, rich in polar functional groups, was fabricated via an electrospinning technique. This separator forms a supramolecular polymer cross-linked system by joining the FPI and PV polymers through hydrogen bonds between their amide (-NH) and fluorinated (-CF) functional groups. It boasts high porosity (75%), exceptional electrolyte-affinity (775%), strong mechanical strength (15.7 MPa), excellent thermal resistance, and dimensional resistance. Consequently, it exhibits excellent lithium-ion conductivity (3.3 mS cm-1) and high lithium tLi+ value (tLi+ = 0.7), ensuring stable Li plating/stripping. Integration of this separator into high-energy-density anode-free lithium-metal batteries (Cu||NMC) and lithium-ion batteries (MCMB||NMC) leads to improved capacity and extended cycle life. Notably, the Cu||NMC cell containing this separator retains functionality even after exposure to elevated temperatures (140 °C for 1 h), highlighting its exceptional thermal resistance.

Abstract No. 0267 Yosef Nikodimos

Sulfide solid-state electrolytes (SSSEs) are a highly promising alternative for all-solid-state batteries (ASSBs) due to their excellent ionic conductivity and ductility. Despite these advantages, their high sensitivity to moisture in humid environments presents a significant challenge to large-scale commercialization. To address this issue, several strategies have been proposed to mitigate the reaction between SSSEs and moisture. One approach involves modifying the SSSE composition by replacing phosphorus atoms, either partially or completely, in line with the hard and soft acid-base principle. Another effective method is iodization treatment, which has been shown to enhance the atmospheric resilience of SSSEs. In addition to these approaches, nano-level treatments involving Lewis acid additives have emerged as a particularly robust strategy. By dispersing SSSE particles in solution mixtures containing Lewis acids, a protective Lewis acid–base interaction forms with the sulfur atoms in the SSSE structure. This interaction effectively mitigates moisture degradation without negatively impacting ionic conductivity. Comprehensive characterization techniques, including X-ray diffraction, in situ Raman spectroscopy, solid-state nuclear magnetic resonance, and X-ray absorption near-edge structure analysis, confirm that the bulk region of the SSSE remains structurally stable even under prolonged exposure to humid air. This suggests that the Lewis acid additive strategy is highly effective in addressing the moisture instability of SSSEs. Overall, this approach not only enhances the moisture resistance of SSSEs but also offers a viable pathway toward more reliable and practical applications of ASSBs in real-world environments.

Abstract No. 0268 **Ting-Yu Wang**

Zinc (Zn) metal holds a prominent position in aqueous batteries due to its high theoretical capacity (5855 mAh cm-3 , 820 mAh g -1) and relatively low redox potential (-0.76 V vs. SHE) when utilized as the negative electrode. Additionally, aqueous Zn-based batteries are considered promising contenders for the next-generation large-scale energy storage systems. Nevertheless, grid-scale use faces challenges like low output voltage and insufficient energy density compared to traditional Li-ion batteries. To address these issues, we propose the electrolytic Zn||MnO_2 battery, which offers a remarkable theoretical output voltage of 1.991V and an impressive gravimetric capacity of about 570 mAh g^{-1}.[1] However, the electrolytic Zn||MnO2 battery needs to operate in strongly acidic electrolyte, thus the Zn electrode should suppress the hydrogen evolution reactions (HER) and dendritic growth, preventing the short-circuiting and battery explosion risks.

In this work, we applied the MOF-801 as a desolvation layer covering the Zn surface to suppress HER and regulate the Zn ion flux, leading to the uniform Zn surface. Owing to the aforementioned benefits, we prolonged the cycle life of the symmetric cell to nearly 200 times that of bare Zn. Notably, the full Zn||MnO2 cell operating in a strongly acidic electrolyte, demonstrated remarkable output voltage of roughly 1.9V with over 500 cycles. The presence of the MOF-801 layer is essential in this study, as it ensures the Zn anode remains dendrite-free, thereby preventing the short-circuiting risks and maintaining its performance.

[1]Chao, D.; Zhou, W.; Ye, C.; Zhang, Q.; Chen, Y.; Gu, L.; Davey, K.; Qiao, S. Z. An electrolytic Zn–MnO2 battery for high-voltage and scalable energy storage. Angewandte Chemie 2019, 131 (23), 7905-7910.

Abstract No. 0269 Yi-Hung Liu

Conventional lithium-ion batteries (LIBs) use organic liquid electrolytes, which pose significant safety risks due to their flammability and potential for leakage. These concerns limit the viability of LIBs for large-scale energy storage applications. To address this issue, replacing liquid electrolytes with solid-state electrolytes (SSEs) is emerging as a promising solution. SSEs offer good chemical and thermal stability, along with favourable mechanical strength, which ensures battery safety under extreme conditions such as high temperatures, overcharging, or short-circuits [1]. In response to these challenges, we developed polymer/ceramic composite solid-state electrolytes (CSE) films using a facile solution-cast method for both solid-state LIBs and sodium-ion batteries (SIBs).

For the film fabrication, a polymer matrix composed of poly(vinylidene fluoride) and cellulose acetate was mechanically mixed with NASICON-type inorganic ceramic fillers using an organic solvent to form a slurry. The resulting slurry was then tap-cast onto a glass substrate and dried to produce the CSE films. Several key factors, including salt concentration, polymer blend ratio, and filler content were investigated to optimize the properties of the CSEs.

Experimental results show that the lithium-based CSE exhibits a high ionic conductivity of ~5 × 10-4 S cm-1 and a wide electrochemical stability window (ESW) of up to 5.0 V vs. Li/Li+. A lithium iron phosphate-based cell using the CSE retains around 90% of its initial capacity after 200 cycles at 1 C. On the other hand, the sodium-based CSE also demonstrates a high ionic conductivity (~5 × 10-4 S cm-1) and a wide ESW (> 5.0 V vs. Na/Na+). It performs well in a full cell with a layered oxide cathode, retaining about 90% of its initial capacity after 200 cycles at 0.5 C.

References

[1] Wang Q, Jiang L, Yu Y, Sun J. Progress of enhancing the safety of lithium ion battery from the electrolyte aspect. Nano Energy 2019;55:93–114.

Abstract No. 0270 Jin-Rong Chen

Bismuth vanadate (BiVO4) is a highly promising visible-light-driven semiconductor photocatalyst [1]. However, pure BiVO4 photoanodes often suffer from significant charge recombination due to their low carrier mobility and short hole diffusion length, resulting in poor performance in photoelectrochemical (PEC) processes [2]. To address this issue, vacancy defect engineering can be employed to enhance light absorption, charge separation and transport, and surface charge transfer properties. In a recent study, we conducted hydrogen annealing on BiVO4 to create hydrogenated bismuth vanadate (H-BiVO4). Subsequently, we coated a copper oxide nanofilm on H-BiVO4 to create a composite film (CuO/H-BiVO4). Analysis of the PEC experimental results revealed that introducing oxygen vacancies can enhance the photoelectrochemical performance of the CuO/H-BiVO4 heterostructure. This enhancement can be attributed to the increase in carrier densities in CuO/H-BiVO4 photoanodes caused by oxygen vacancies, which in turn increases band bending at the semiconductor/electrolyte interfaces, thereby promoting charge separation and transfer. In this study, we explored the impact of vacancy defects in the BiVO4 layer on the PEC performance of the composite system. This achievement demonstrates the potential application of CuO/H-BiVO4 composites in water splitting and energy conversion. Finally, we thoroughly examined the role of vacancy defects in BiVO4 photoanodes and their influence on tuning the electronic structure and promoting charge separation efficiency.

Abstract No. 0271 Po-Hsiang Wang

This study is focused on enhancing the photoelectrochemical (PEC) properties of semiconductor materials Bi2O3 and ZnO by increasing oxygen vacancies [1,2]. These vacancies are intended to improve the separation efficiency of photogenerated electrons and holes, thereby boosting performance in photocatalytic and PEC applications. The researchers employed a two-step process to create bilayer sheets enriched with oxygen vacancies. They first deposited triangular Bi2O3 nanosheets on fluorine-doped tin oxide (FTO) using hydrothermal and annealed it in ambient air at 370°C. Subsequently, the samples were annealed in hydrogen at 250°C to increase oxygen vacancies further. ZnO was then sputtered onto the Bi2O3 layer, with the substrate temperature raised to 200°C to enhance vacancies in ZnO. PEC measurements, including photocurrent densityvoltage curves, Nyquist plots, and Mott-Schottky plots, were utilized to evaluate the samples. The results revealed a Z-scheme formation between the hydrogen-annealed Bi2O3 and sputtered ZnO. The tests demonstrated that β-Bi2O3 annealed in hydrogen at 250°C, combined with ZnO at 200°C, exhibited superior PEC properties and improved electron-hole separation efficiency compared to the individual materials. This study successfully utilized hydrothermal and sputtering methods to fabricate oxygen vacancy-enriched Bi2O3-ZnO bilayer materials on FTO, enhancing PEC and photocatalytic properties while maintaining stability through repeated use.

Abstract No. 0272 **Chun-Liang Chang**

This study investigates the fabrication and performance evaluation of a Metal-supported Solid Oxide Cell (MS-SOC) produced using atmospheric plasma spray (APS) at the National Atomic Research Institute. The MS-SOC incorporates composite electrolytes, consisting of Sm-doped ceria and Sr- and Mg-doped materials. Initial tests were conducted in fuel cell mode, after which the cell was assembled into a stack for hydrogen production evaluation.In fuel cell mode, the 10×10 cm^2 MS-SOC achieved power densities of 444, 660, 798, and 859 mW/cm^2 at 600°C, 650°C, 700°C, and 750°C, respectively, when operated at 0.7 V. Long-term stability tests were also conducted in fuel cell mode at 700°C for a duration of 540 hours. The results indicated a degradation rate of approximately 1% per 1000 hours under these conditions.In electrolysis mode, the MS-SOC cell demonstrated a hydrogen production rate of 0.6 L/min per cell at 700°C, with a cell voltage of 1.17 V and an applied current of 80 A. The cell showed a hydrogen production efficiency of 88.03% (LHV) at 700°C. To prevent excessive oxidation of the hydrogen electrode and substrate, additional hydrogen was supplied, maintaining an H2/H2O ratio of 20/80 and a water flow rate of 0.64 mL/min. Preliminary long-term testing of the cell has completed 100 hours, with no significant degradation observed to date.

Abstract No. 0273 **Lei Kerr**

Commercially available disposable screen-printed electrodes (SPEs) offer a rapid and cost-effective method for determining the concentration of the biomarker 8-OHdG in artificial urine. The electrochemical behavior of 8-OHdG, a biomarker for ROS-induced stress, was analyzed using both cyclic voltammetry and differential pulse voltammetry. The oxidation of 8-OHdG was identified as quasi-reversible, with a linear response of the SPE observed between 0.001 mM and 0.1 mM in PBS. The sensitivity was calculated at 9.89 μA/mM, with a detection limit of 0.0017 mM. The variation between individual SPEs averaged less than 8% within this concentration range. Additionally, the pH of the solution significantly affected the peak potential, showing an inverse linear relationship, while the peak current remained constant.

Abstract No. 0274 Chia-Chen Li

In this study, we present a comprehensive investigation into the fabrication and optimization of composite solid electrolytes (CSEs) by integrating advanced ceramic (Li6.4La3Zr1.4Ta0.6O12, LLZTO) structures with a polymer matrix (PVDF-HFP), as well as exploring the densification mechanisms of garnet-based electrolytes. Utilizing 3D printing technology, we fabricate an LLZTO pillar array structure (250 μm diameter, 130 μm height), which serves as a continuous pathway for efficient Li+ conduction, enhancing ionic conductivity and solid-state battery performance. This array structure is compared with a CSE featuring dispersed LLZTO particles in PVDF-HFP, demonstrating the superior benefits of the structured array on Li+ transport and overall battery efficiency. To further understand the Li+ trajectory and flux distribution within the CSEs, we conduct numerical simulations using finite element analysis (FEA), providing valuable guidance for optimizing the design and stability of solid-state batteries. Additionally, we examine the densification processes of LLZTO electrolytes through both experimental methods and FEM simulations.

Abstract No. 0275 Divyavalli

"Aqueous organic redox flow batteries (AORFBs) have gained attention as promising candidates for large-scale energy storage due to their inherent scalability, environmental friendliness, and the tunability of organic redox-active materials. The performance of AORFBs is largely dependent on the interaction between the redox-active species and the electrode materials. Carbon-based electrodes, particularly carbon felt, are widely used because of their high surface area, good electrical conductivity, and chemical stability in various electrolytes. However, the inherent hydrophobicity and limited active sites on untreated carbon felt can hinder the efficient electron transfer and the wettability required for optimal redox reactions.

To address these limitations, electrode modification has emerged as a critical approach to enhance the performance of AORFBs. Various strategies, such as thermal treatment, chemical oxidation, and incorporation of catalytic or conductive materials, have been employed to improve the electrochemical activity, wettability, and surface functionality of the electrodes. The introduction of metal oxides, including cobalt-doped zinc oxide (Co-ZnO), has been shown to facilitate faster redox reactions by increasing the active surface area and introducing catalytic properties. Double modification followed by the treatment of carbon felt with ammonium persulfate and then the deposition of Co-ZnO enhance the hydrophilicity of the electrode, further improving electrolyte access and reducing charge transfer resistance.

In this study, we investigate the performance of carbon felt electrodes modified with Co-ZnO in the presence of TEMPO (2,2,6,6-Tetramethylpiperidinyloxyl) as the catholyte and methyl viologen as the anolyte. The aim is to improve the electrochemical efficiency of the system by enhancing the interaction between these redox-active species and the modified electrodes. Through a combination of thermal treatment and solvothermal deposition, we demonstrate that the modified electrodes show superior performance in terms of electrolyte utilization and redox activity, without the need to alter the electrolyte composition."

Abstract No. 0276 **Chun Kai Hung**

The battery pack in electric stackers is the core power source, making the safety and performance of the battery management system crucial. This article focuses on using the NUVOTON Cortex-M4 chip as the control core to develop a battery management system specifically for electric stackers. The system integrates custom-designed battery monitoring and sensing circuits to enhance efficiency, prevent overcharging and over-discharging, and extend battery life. The stacker operates for approximately 5 hours a day with a power consumption of about 48AH per hour, requiring a 7S12P (240AH) battery module. Experimental results show that the designed battery management system effectively supports the stacker's operational needs.

Abstract No. 0277 **Rajesh kumar Raghav**

Vibrio harveyi bacteria are pathogenic to many marine fish and shellfish species and Vibrio harveyi species are a diverse group of waterborne pathogens. However, a reliable and rapid method has not been developed for detection of V. harveyi. Therefore in this paper, we developed a sensitive and rapid electrochemical biosensor based on Au@MOF accelerator for the detection of Vibrio harveyi pathogens. We have used Au@MOF on SPCEs surface to enhance the conductivity of this biosensor, which has good conductivity. Gold metal-organic framework (Au@MOF) as electrode substrate has large surface area, which can absorb nucleic acids and act as an accelerator to promote electron transfer. This is new strategy of EIS using Au@MOF; sensitive bacteria detection is highly desirable. Therefore, this study processed the aptamer on Au@MOF coated SPCEs, found that it has better electrochemical characteristics and can improve the electrochemical signals. Based on the Au@MOF, we have developed a novel electrochemical bio-sensor to detect Vibrio harveyi bacteria rapidly.

So far, various types of the electrolyte materials have been successfully tested in supercapacitors but the aqueous electrolytes, which belong to the group of liquid-based electrolytes, are still the most frequently studied due to their accessibility and costs [1]. However, their electrochemical stability window (ESW) is very low due to the water decomposition on the electrodes at 1.23V. Another branch of liquid-based electrolytes constitutes the organic electrolytes and ionic liquids. They offer much wider ESW than aqueous electrolytes but they are toxic and quite expensive. Recently, it has been developed cheaper equivalent of ionic liquid electrolyte which is based on a deep eutectic solvent (DES), i.e., a fluid composed of two or three components which are capable of self-association mainly due to the presence of hydrogen bonds and their interactions [2]. Completely different group of electrolyte materials is related to solid-state electrolytes whose main advantages are high ESW, no leakage of electrolyte, flexibility, and stability [3].

Taking the advantage of both DES and solid-state electrolytes, a new synthesis path towards the quasi-solid state electrolyte composed of gel-like polymer membrane soaked with DES solvent is proposed herein. In this work, the DES is based on an aqueous mixture of LiClO4 and methylsulfonylmethane (MSM), while the pomer membrane constitutes the porous poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP) film. The prepared electrolyte material has been morphologically, structurally and electrochemical characterized with use of several complementary methods such as: XRD, FTIR, Raman Spectrocopy, SEM, BET, CV, and GCD. The obtained results indicate that the investigated hybrid quasi-solid state electrolyte material satisfies all necessary conditions for the application in high-voltage supercapacitors.

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Abstract No. 0279 Masayuki Morita

Zinc (Zn) exhibits the lowest potential (-0.76 V vs. SHE) among reversibly redox-capable metals in aqueous electrolytes, and has high specific capacity (Ah/kg) with a two-electron reaction. Therefore, a battery using Zn as a negative electrode can be expected to have a high specific energy (Wh/kg). The development of nickel-zinc (Ni-Zn) batteries using nickel hydroxide (Ni(OH)2) as the positive electrode active material is underway, but if a positive electrode active material with low resource risk and high specific capacity can be used, it is possible to construct a rechargeable battery that is safe and has a higher energy density than Ni-Zn batteries. RISING3, a NEDO-contracted battery R&D project in Japan, aims to develop a rechargeable battery with water-based electrolyte that can eventually surpass the performance of the Ni-Zn system.

Ni-Zn batteries were used as benchmarks to obtain information on the selection of cell constituent materials and the optimization of their structure. Fig. 1 shows the position of cell capacity and specific energy (energy density per mass) of commercially available Ni-Zn batteries and alkaline manganese primary batteries (both AA type) with respect to the intermediate and final goals of the project. It was found that the energy density of a practical battery using zinc as a negative electrode is about 100 Wh/kg, but it can be improved to nearly 150 Wh/kg by optimizing the cell configuration (Ni-Zn (Gen1), Ni-Zn (Gen2): in-house production).

In developing an innovative storage battery featuring high energy density, we set issues for the following elemental technologies:1) Development of high-potential and high-capacity cathode active materials. 2) Development of Zn anode combination electrode that enables high reversibility. 3) Development of electrolyte and separator.

This research was conducted as part of the "Development of Innovative Rechargeable Batteries for Electric Vehicles (RISING3)" (JPNP21006) commissioned by the New Energy and Industrial Technology Development Organization (NEDO). I would like to express my gratitude to everyone involved.

Abstract No. 0280 Yu-Cheng Lu

This study introduces an innovative method for utilizing visible light to catalyze the color development of TMB, employing a platinum nanoparticle-silicon carbide (SiC_Pt) composite material as the photocatalytic substrate. Semiconductor-based nanozymes, particularly those made from SiC, are prized for their exceptional chemical and thermal stability, allowing them to maintain high reliability in diverse environmental conditions. By combining SiC with platinum nanoparticles, the surface plasmon resonance (SPR) effect not only facilitates the transfer of high-energy electrons to the semiconductor's conduction band but also extends their lifetime, significantly enhancing photocatalytic efficiency.

Abstract No. 0281 Rui-Tung Kuo

The application of an amorphous Li7La3Zr2O12 (a-LLZO) thin film to modify the surface of garnet-type Ta-doped Li7La3Zr2O12 (LLZTO) plays a crucial role in enhancing the performance and durability of lithium solid-state batteries. While LLZTO exhibits high ionic conductivity and stability with lithium metal, challenges remain in controlling lithium growth morphology during charge and discharge cycles. The a-LLZO thin film was designed to suppress the formation of lithium dendrites, a major cause of short circuits and battery failure, and to prevent current leakage when external energy is applied [1]. By mitigating these risks, a-LLZO helps to improve the electrochemical stability of the electrode-electrolyte interface[2], [3]. Additionally, since lithium ions primarily migrate along grain boundaries in crystalline LLZTO, the amorphous nature of a-LLZO presents a more uniform and defect-free interface that could hinder unwanted lithium deposition and enhance overall lithium-ion transport efficiency.

Potentiostatic and galvanostatic tests were conducted to investigate the critical conditions under which a-LLZO effectively protects the interface further. The results highlight the potential of a-LLZO to serve as a barrier to dendrite growth and improve charge-transfer kinetics, which is crucial for enhancing stripping-plating behavior during cycling. This modification not only improves the electrochemical performance but also opens new possibilities for the application of thin-film materials in advanced lithium-based energy storage systems.

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Abstract No. 0282 Yu-Ting, Chueh

The reliance on fossil fuels has significantly contributed to global warming and climate change, underscoring the urgent need for alternative energy sources. Hydrogen presents a promising solution and can be produced through water electrolysis. Given that over 97% of the earth's water is seawater, developing seawater splitting technologies offers substantial economic benefits. However, the presence of chloride ions during seawater

electrolysis leads to severe catalyst corrosion. To address this challenge, in this study, we incorporated corrosion-resistant molybdenum ions into a highly porous NiFe metalorganic framework electrocatalyst. This incorporation not only imparts anti-corrosion abilities but also regulates the 3d orbitals of nickel active sites, as evidenced by Kβ2,5 X-ray emission spectroscopy and resonant inelastic X-ray scattering. The resulting electrocatalyst demonstrates an outstanding overpotential (η10) of 120 mV to reach a current density of 10 mA/cm2 for alkaline seawater electrolysis, overperforming the pristine NiFe electrocatalyst (η10 ~ 320 mV). Remarkably, NiFeMOF-Ce exhibits impressive performance at 100 mA/cm2 (η100) with an overpotential of 180 mV. When integrated into a membrane electrode assembly, the catalytic current density exceeded 1 A/cm2. Operando X-ray absorption spectroscopy unveiled that cerium ions stabilize the coordination environment of nickel active sites, while rapidly activating their valence state, contributing to the high activity of our developed electrocatalysts. This study provides valuable insights into the design of efficient and selective seawater electrocatalysts employing non-noble metals.

Abstract No. 0283 Masashi OKUBO

Lithium-ion batteries (LIBs) dominate the battery market for portable electronics and electric vehicles owing to their long lifetime, high efficiency, and high energy densities. However, LIBs are comprised of flammable and costly organic electrolytes, which unexceptionally accompany both safety hazards and high fabrication costs. Batteries that utilize aqueous electrolytes are expected to provide more operational safety, affordability, high power, and environmental benignity, all of which are favorable for large-scale stationary systems and electric vehicle operations. Although the intrinsically narrow electrochemical stability window for water as an electrolyte solvent (1.23 V) imposed severe limitations on any practical applications of aqueous batteries, novel strategies involving highly concentrated aqueous electrolytes have achieved much wider electrochemical potential windows (>3 V), thereby paving a path for the development of more practical aqueous batteries. Importantly, highly concentrated aqueous electrolytes can provide unexpected environments for electrode materials that have been considered 'useless' in conventional dilute aqueous electrolytes. I will show our recent attempts to explore anomalous solid-state electrochemistry in aqueous media.

Abstract No. 0284 T. Mori

Gold-based MEMS capacitive accelerometers with a Ti/Au multi-layered structure are developed to enhance the sensitivity and structural stability [1]. The high mass density of Au allows reduction the thermal mechanical noise [2]. On the other hand, warpage deformations are observed in the square-shaped proof masses, particularly at the corners. The warpage was suggested to be induced by thermal treatment due to mismatched thermal expansion coefficients between Ti and Au [3]. While thermal treatment can effectively eliminate impurities leading to drift phenomena [4, 5], it also contributes to warpage.

This study aims to mitigate warpage by implementing an octagonal-shaped proof mass design and to explore the correlation between thermal treatment temperature and warpage behavior. The octagonal proof mass was manufactured using lithography and Au electroplating (Fig. 1), and warpage was assessed using a 3D optical microscope before and after thermal treatments at temperatures up to 300 °C. Additionally, finite element analysis (FEA) simulations were conducted to simulate the warpage.

The results revealed that the warpage increased with higher thermal treatment temperatures (Fig. 2), but the octagonal design demonstrated less warpage compared to the square design. FEA simulations further validated the superior stability of the octagonal design.

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Abstract No. 0285 Shota Kanno

Gold-based Micro-Electro-Mechanical Systems (MEMS) accelerometers are known for their minimal mechanical noise and exceptional sensitivity, attributes that stem from gold's high mass density (19.3 g/cm^3). Electrodeposition is a straightforward process for creating components for MEMS devices. However, unlike larger counterparts, micro-scale MEMS device components exhibit unique mechanical properties due to the sample size effect. This study aims to evaluate the rate dependency of micro-mechanical properties in electrodeposited gold, with the goal of applying these findings to MEMS device components.

An approximately 30 μm thick gold film was electrodeposited under a constant current density of 1.0 A/dm^2. Three differently sized micro-pillars were then fabricated from the electrodeposited gold film using Focused Ion Beam (FIB) technology. Compression tests were performed at various strain rates. Following the micro-compression test, the electrodeposited gold micro-pillars deformed into a barrel shape. The results indicated an increase in yield strength with decreasing pillar size, highlighting the sample size effect. Additionally, the yield strength was observed to increase with higher strain rates.

Abstract No. 0286 **Chao-Tsung Ma**

In response to carbon reduction policies and the continued increase in electricity demand, the world is adapting to new energy revolution and the impact of energy transition. This paper aims to investigate an intelligent power conversion system (IPCS) for the PV-ESS power system and designs the required power converters with advanced control schemes. The proposed IPCS power converter hardware system includes a buck-boost DC/DC power converter for integrating photovoltaic systems, and a multi-control mode bidirectional DC/DC power conversion system (PCS) for battery energy storage system (BESS) and a three-phase DC/AC converter that can be operated in stand-alone and grid-connected modes. The BESS battery used in this paper is a set of vanadium redox flow battery (VRFB) as shown in Fig.1. In addition to the basic power control functions, there is an advanced IPCS control scheme investigated in this paper, i.e., IPCS's programmable multi-mode integration and conversion control scheme. This paper will demonstrate a set of control modes and typical results of a 5kVA small-capacity IPCS system to verify the performance of the proposed control schemes. To improve the efficiency and reliability of the system, the power converters of IPCS are designed with the third-generation wide-gap semiconductor, silicon carbide (SiC) switching devices, and the converters' controller will be designed with a digital signal processor (DSP) to achieve fully digital programmable control scheme and the integration of multi-mode optimized control functions. The feasibility and overall performance of the advanced control schemes proposed in this paper will be analyzed with software simulations and the TI DSP TMS320F28335 chip will be used as the control core to cooperate with the related equipment in laboratory to carry out the hardware implementation verification and system-wide performance evaluation with a 5kVA small-capacity IPCS experimental system.

Abstract No. 0287 **Chao-Tsung Ma**

The full electrification of vehicles and the rapid increase of various charging stations have become an inevitable trend. This paper aims to demonstrate a multi-mode fast charging system (MFCS) for electric vehicle (EV) batteries with flexible system control functions. The proposed MFCS is based on a two-stage power converter architecture. As shown in Fig.1, the first stage of MFCS is a three-phase AC/DC grid-tied inverter used as the interface between the power grid and the MFCS's DC link. It is designed to perform a flexible operation of real/reactive power flow control and to balance the current in the charging process of the EV battery bank. If necessary, it can also concurrently perform the real-time reactive power compensation for the grid. The second stage is a three-channel hybrid interleaved DC/DC converter used for performing optimized fast charging or discharging of EV batteries. In some operation conditions, the second stage DC/DC converter can be converted into a grid-connected inverter via structural switches to enhance the reactive power compensation capability of the proposed MFCS. To achieve a flexible EV battery charging system, a digital signal processor is used as the control core of MFCS to achieve a fully programmable digital control scheme with an integrated multi-mode control mechanism. The proposed MFCS can be operated in an integrated multi-functional control mode in line with the conditions of electric vehicles and power grids. Its main functions include: 1) MFCS high-efficiency electric vehicle charging mode; 2) MFCS grid voltage supporting mode; 3) MFCS electric vehicle charging and grid voltage supporting integrated control mode; 4) MFCS real power and grid frequency supporting mode. The feasibility and overall performance of the proposed MFCS will be demonstrated with results of simulation cases and verified with a small capacity 5kVA MFCS experimental system.

Abstract No. 0288 **Sanjana K.**

Abstract Silicon have been identified as an alternative new material and is been proven to be an excellent anode material for high-energy LIBs due to their excellent theoretical capacity (4200 mAhg-1), attractive discharge potential (0.2 - 0.4 V V/s Li/Li+) and low toxicity. However, it undergoes volume expansion (~ 400%) during lithiation and delithiation process, which causes pulverization of particles leading to cracks in the internal structure of Si and repeated growth of high and thick solid electrolyte interphase (SEI) which intern leads to low initials columbic efficiency, rapid capacity fade and low rate capability of battery. Therefore, in order to overcome these critical issues and to enhance the Si anode performance some strategies developed are various morphological designs, synthesis of composites with Si and modifying the surface of Si anode and reducing the anode-electrolyte interphase kinetic barriers. In this study, we will do research on the surface modification of Si. In this 3-mercaptopropyl trimethoxysilane (MPTMS), is tailored on the surface of Si. The MPTMS acts as a coupling agent with thiol (-SH) functional group and is functionalized as a modification. And by using organosilane reaction and by forming strong Si-O-Si covalent bonds leads to the formation of artificial SEI on the Si surface, which inhibits the volume expansion. In the further reaction mechanism, the thiol (-SH) group is replaced by gold nanoparticles (AuNPs), which enhances the electrical conductivity and improves the interface kinetics for fast charging. In the latter part of the reaction, in order to increase the life cycle an oxidation reaction is carried out into a sulfonic acid

(SO3H) group which acts as a functional group to be pre-lithiated by replacing -OH group with Li+ ions. This study provides a new approach for fast charging with low cost for next generation LIBs.

Abstract No. 0289 Yu-Sheng Su

In this study, we advance lithium-ion capacitor (LIC) technology by implementing a dual chemical prelithiation approach.[1,2] Using lithium-biphenyl solution for the prelithiation of both hard carbon anodes and activated carbon (AC) cathodes, we achieve significant performance improvements. The LIC cell demonstrates an impressive energy density of 98 Wh/kg at 0.5C, with 47% of reversible capacity retained at 20C, making it one of the top-performing LICs to date. Precise control of prelithiation levels in the AC cathodes is essential to prevent unwanted lithiation and aluminum corrosion, ensuring enhanced stability and efficiency in LICs. In parallel, we explore small molecule polycyclic aromatic hydrocarbons (SMPAHs) such as naphthalene, biphenyl, 9,9-dimethylfluorene, phenanthrene, p-terphenyl, and pyrene as promising candidates for lithium-ion battery (LIB) anodes.[3] These SMPAHs offer high specific capacities, exceptional cycle stability, and strong rate capabilities. Notably, the SMPAH anodes retain over 92% of their capacity after 1500 cycles, with a Coulombic efficiency approaching 100%. However, the study highlights a challenge with pyrene dissolution, which leads to structural collapse due to the vertical expansion of pyrene dimers. These findings open new pathways for the development of high-performance LIB anodes and energy storage systems.

Abstract No. 0290 Hou-Chien Chang

In this work, the finite element method using COMSOL 6.1 was employed to simulate the non-uniformity (NU%) and thickness distribution of copper deposition in a panel-level electroplating system. A variety of electroplating conditions were examined to compare the effects of key variables on NU%, including the width of the auxiliary cathode, the size of the central openings in the cathode and anode masks, and the thickness of the seed layer. The influence of these electroplating conditions on the uniformity of copper deposition was investigated, and the deposition results were analyzed. A Central Composite Design (CCD) was used for the experimental design to gather simulation data. Response Surface Methodology (RSM) was utilized to predict the optimal control variables for minimizing deposition thickness NU% within the ranges of simulation conditions. Additionally, first and second-order regression analyses were conducted to estimate the performance characteristics of the simulations, and the resulting regression equations were consistent with the observed NU% in copper electroplating. This study successfully identified optimized electroplating conditions with RSM, which are (1) an auxiliary cathode width of 3600 μm, (2) a central opening size of 548 mm for the cathode mask, (3) a central opening size of 500 mm for the anode mask, and (4) a seed layer thickness of 0.15 μm. Confirmatory experiments illustrated that, compared to the original electroplating conditions, the NU% decreased from 20.32% to 12.26% under the combination of optimal control factors. Thus, this research developed a reliable numerical model for copper electroplating deposition, and provided a theoretical reference for improving deposition uniformity.

Abstract No. 0291 Chen-Xi Hu

High-entropy alloys (HEAs) are crystalline solids that are frequently composed of five or more elements. Their enhanced physicochemical properties have recently garnered significant attention in comparison to conventional alloys. High-entropy alloys exhibit exceptional efficacy in a variety of electrocatalytic processes. However, the utilization of HEA catalysts in the glycerol oxidation process (GOR) has not received an adequate amount of attention. Due to the numerous types and architectures of HEA materials, there is a substantial opportunity to improve GOR HEA electrocatalysts. Consequently, the study's objectives are to utilize solvothermal synthesis to produce a multi-metal-glycerate material on the surface of graphite felt electrodes, and to assess the material's capacity to expedite the hydrogen evolution reaction by adjusting the reaction temperature, time, and glycerin concentration. At a current density of 10 mA cm-2, the optimal process parameters demonstrated a charge-transfer resistance of 6.98 Ω and a lowest overpotential of 308 mV.

Abstract No. 0292 Yang-Sheng Lu

In this study, we developed a two-step electrochemical method to fabricate Palladium-Nickel nanodendrite heterostructures for use as non-enzymatic glucose sensors. The objective was to leverage the excellent sensitivity and selectivity of Nickel, combined with the high stability of Palladium, to achieve efficient glucose detection. Initially, we optimized the electrodeposition of Pd nanodendrites at different potentials, identifying -0.195 V for 30 minutes as the condition yielding the largest electrochemical surface area. Subsequently, Nickel was electrodeposited onto the Pd nanodendrites at a current density of -4 mA/cm² for 75 seconds, resulting in the formation of the Pd-Ni75s/C electrode.

The Pd-Ni75s/C electrode exhibited a high sensitivity of 1696 μA/cm²·mM under alkaline conditions, with a detection linear range of 0–8 mM glucose, covering human blood glucose levels. It achieved a limit of detection (LOD) of 2 μM and a rapid response time of 1.5 seconds. Furthermore, the sensor demonstrated excellent selectivity, showing no oxidative reaction currents in the presence of ascorbic acid, uric acid, fructose, lactose, dopamine, and chloride ions. Importantly, it was resistant to poisoning by these interfering species and maintained good reproducibility, retaining 85% of its efficacy after 30 days.

Abstract No. 0293 **Wei-Ting Tu**

The electrochemical reduction of carbon dioxide (CO2RR) to valuable hydrocarbon products offers a promising approach for mitigating the rising concentration of CO2 in the atmosphere. Among monometallic catalysts, copper (Cu) is the most promising one due to its unique and moderate binding energy with intermediates, facilitating the production of high value multicarbon (C2+) products. However, the low selectivity towards multicarbon products remains a significant challenge. Previous studies have shown that purging CO2, as a capping agent during Cu electroplating, leads to the formation of faceted Cu surfaces, espacially the (100) facet, which enhances the production of C2+ products by promoting CO dimerization. Furthermore, researchers have observed that increasing the cation radius in the electrolyte in CO2RR testing tends to improve the selectivity for C2+ products, although there's no definitive conclusions yet.

In this study, we introduce a method for Cu electrodeposition in a CO2 environment by changing the cation (Li, Na, K, Cs) in the electrolyte. With a pulsed electrodeposition method and high voltage conditions, we succesfully manipulated the growth of a more faceted Cu surface in the Cs electolyte case while no similar structure in other cases. CO2RR tests revealed that this structure exhibited high selectivity for multicarbon products at high current densities (84% at -300 mA cm-2). Detailed characterization of the prepared materials using SEM, TEM, and XRD will be presented. Additionally, in-situ infrared spectroscopy studies are planned to provide further insights into the dynamic environment of the catalysts during electrodeposition.

Abstract No. 0294 **Jeng-Yu**

The increasing worry over the depletion of nonrenewable energy sources has sparked a widespread interest in clean and sustainable energy alternatives. As clean energy sources such as solar and wind power are intermittent and reliant on weather conditions, the need for reliable energy storage and efficient conversion technologies has become increasingly critical. In our study, we present a novel deep eutectic solvent (DES) based on methyl urea, incorporating Zn2+/Na+ dual cations. We have modified the solvent's physicochemical properties by adding co-solvents such as acetonitrile and water. The interaction between the constituents of the electrolytes has been thoroughly examined using spectroscopic techniques. We have employed a cost-effective chemical approach to synthesize the polyaniline-decorated graphene nanofiber (GPANi) as the cathode material. The kinetics study of GPANi in DES electrolytes suggests that its charge storage mechanism involves both battery-like and pseudocapacitive behavior. The Zn//GPANi device with DES electrolyte delivers a maximum energy density of 101 Wh kg−1 at a power density of 274 W kg−1 and exhibits outstanding rate capability. Additionally, the cell retains 78% of its initial capacity after 1600 cycles at a high current density of 2 Ag−1. Our device can consistently function at −10 °C with an operating voltage of 2.2 V, a feat not typically achievable for traditional aqueous electrolytes.

Abstract No. 0295 Asif Latief Bhat

Silicon (Si) is recognized as a highly promising anode material for next-generation lithium-ion batteries (LIBs) due to its exceptional theoretical capacity [1]. However, practical application is hindered by significant challenges, including volume expansion, particle pulverization, solid electrolyte interphase (SEI) formation, and low initial Coulombic efficiency (ICE) [2,3]. While these issues have been extensively studied, this work specifically addresses a critical yet underexplored issue: Coulombic efficiency (CE) troughs in Si anodes. CE troughs, which can severely impact battery performance and reliability in full-cell configurations, are influenced by factors such as electrode thickness, Si particle size, cycling rate, electrolyte composition, and voltage range. Our study presents a comprehensive analysis of this phenomenon, revealing that thinner electrodes and slower cycling rates accelerate the onset of CE troughs. In contrast, the use of a THF-based electrolyte and a narrower voltage window (0.01–0.5 V) stabilizes electrochemical performance and prevents CE troughs. Structural analyses using HAADF-STEM and SEM correlate the severity of CE troughs with electrode volume expansion, delamination, and the formation of a sponge-like structure in the SEI. These insights provide a deeper understanding of CE trough mechanisms and suggest strategies to mitigate their occurrence by optimizing electrode design, electrolyte selection, and cycling parameters, advancing the development of durable high-performance LIBs.

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Abstract No. 0296 林敬捷

In recent years, there has been significant attention given to energy depletion. Many researchers have focused on studying high-performance energy storage devices, with a particular emphasis on supercapacitors. In this study, a straightforward technique was developed to create a bimetallic Co0.85Se/Ni3Se2 heterostructure through a one-step electrodeposition process. The resulting structure has proven to be an efficient cathode for fast charge/discharge electrochemical energy storage devices The composition and morphology of the cathode materials can be easily adjusted by varying the molar ratio of Co/Ni precursors. The optimized Co0.85Se/Ni3Se2 (3:1) electrode exhibited an impressive specific capacity of 141.9 mAh g−1 at a current density of 1 A g−1. It maintained a capacity of 103.5 mAh g−1 at a high current density of 8 A g−1 due to its heterostructure nature, with a 73% capacity retention. The optimized cathode used in the assembled hybrid supercapacitor (HSC) device achieved impressive energy and power densities. Furthermore, the Co0.85Se/Ni3Se2 (3:1) electrode was successfully employed in micro-HSC (μ-HSC) applications, demonstrating excellent cycling stability during 480-hour floating tests. These results indicate that the synthesized Co0.85Se/Ni3Se2 cathode holds great potential for high-performance electrochemical energy storage devices.

Abstract No. 0297 Tom Macdonald

See Attached

Abstract No. 0298 Abstract No. 0298

This paper elucidates the utilization of Li2TiSiO5 coated with a thin layer of carbon (LTSO/C) as an efficient anode material for lithium-ion batteries (LIBs). The material was synthesized using the sol-gel technique with varying amounts of polyvinylpyrrolidone (PVP) as a carbon source. The physicochemical characterization of the LTSO/C samples reveals that the particle diameter of LTSO decreases as the quantity of PVP used in the sol-gel synthesis process increases. In addition, the study indicates that a thin non-crystalline carbon layer forms on the surfaces of LTSO, along with additional carbon networks connecting the LTSO particles. The electrochemical study showed that increasing the amount of PVP during synthesis resulted in an LTSO/C composite electrode with 1 g of PVP exhibiting a specific capacity of 274.5 mAh·g−1 at 0.1C after 150 cycles, which is close to the theoretical capacity. This LTSO/C electrode demonstrates excellent electrochemical performance at high rates, surpassing a discharge capacity of 170 mAh·g−1 up to 2 C. Therefore, LTSO/C is an excellent choice for high-performance anode materials in LIBs.

Abstract No. 0299 Zhi-Ting Huang

In recent years, zinc-ion batteries (ZIBs) have emerged as a promising choice for energy storage due to their high energy density, safety, cost-effectiveness, and eco-friendliness. However, they have encountered challenges such as zinc dendrite growth and poor cycling stability. In this study, a cost-effective and environmentally friendly deep eutectic solvent (DES) made of acetamide, sodium perchlorate, and zinc chloride was developed as the electrolyte for dual-ion batteries. A Prussian blue analog (K–MnHCFe) was utilized as the cathode. The device demonstrated a discharge capacity of 76.4 mAh g^{-1} at a current density of 0.3 A g^{-1} and attained a maximum energy density of 111.7 Wh kg^{-1} at a power density of 437.5 W kg^{-1}. Furthermore, even after 3000 cycles at a current density of 0.5 A g^{-1}, it retained 65% of its initial specific capacity, surpassing traditional $ZnSO_4$ aqueous electrolytes. This study illustrates that Na+/Zn2+ dual-ion batteries are a promising, safe, and cost-effective energy storage solution for various applications.

Abstract No. 0300 Chen-Yu Wu

The oxygen evolution reaction (OER) is a pivotal step in electrochemical water splitting and energy conversion, yet it suffers from sluggish kinetics, demanding the development of efficient and durable electrocatalysts. Two-dimensional (2D) layered double hydroxides (LDHs) have emerged as promising materials for OER due to their high surface area, tunable composition, and layered structure, which allows for efficient charge transfer and exposure of active sites. In particular, the synergistic interaction between cobalt (Co) and iron (Fe) in $Co_{1-x}Fe_x(OH)_2$-based LDHs has shown significant potential in enhancing the catalytic performance for OER [1]. In this work, we report a novel synthesis strategy combining alkylamine-confined growth, sulfate ion decoration, and probe sonication to prepare ultrathin $Co_{1-x}Fe_x(OH)_2$-SO_4 nanosheets. The sonication process exfoliated the layered structures, reducing the thickness and improving the material's intrinsic conductivity and mass transfer properties. This green and scalable approach significantly enhances the catalytic activity of the LDH system without the need for harsh chemical treatments. The optimized composition, $Co_{0.75}Fe_{0.25}(OH)_2$-SO_4, achieved remarkable OER performance with a nanosheet thickness of 1.39 nm. It demonstrated an overpotential of only 209 mV at 10 mA/cm^2 in 1 M KOH, confirming its superior catalytic efficiency and stability. These findings indicate that the designed $Co_{1-x}Fe_x(OH)_2$-SO_4 material could serve as a highly efficient and environmentally sustainable electrocatalyst for future renewable energy technologies.

Abstract No. 0301 Yun-Cih Cai

Volatile amines, including dimethylamine (DMA) and trimethylamine (TMA), are key indicators of seafood spoilage. Due to their toxicity and potential carcinogenicity, monitoring DMA and TMA is essential not only in food science but also in workplaces where fish is handled. Exposure to these amines can cause irritation of the skin, eyes, and mucous membranes, while prolonged exposure to high concentrations of these amines significantly increases health risks, including cancer. Therefore, developing accurate and sensitive detectors for both DMA and TMA is crucial to ensure food safety and protect occupational health.[1]. In this study, we developed an electrochemical sensor capable of detecting low concentrations of dimethylamine (DMA) by utilizing few-layer molybdenum disulfide (MoS_2) as the substrate for the working electrode. In addition to analyzing the surface morphology, crystal structure, and chemical composition of the materials using SEM, XRD, Raman, and FTIR spectroscopy, we also examined their electrochemical properties. Although MoS_2 exhibits good electronic properties, its application in sensing is limited by poor electrocatalytic oxidation and low charge mobility. To address these challenges, MoS_2 was modified with copper (Cu) nanoparticles, which enhanced electron transfer, increased surface area and active sites, and improved both conductivity and electrocatalytic performance. Copper decoration catalyzes the oxidation of DMA, thereby significantly enhancing the sensor's sensitivity. Furthermore, we conducted interference tests with common seafood components, including Ca^{2+}, K^+, Na^+, bovine serum albumin, glucose, and ammonia, which demonstrated minimal interference and validated the sensor's sensitivity. To ensure practical feasibility, we also investigated environmental factors, aiming to enable more effective and accurate sensor application in assessing fish freshness. This study confirms the feasibility of applying the electrochemical DMA sensor for evaluating the freshness of fish.

Abstract No. 0302 Pin Lui

This study prepared titanium dioxide (TiO_2) nanopowder coatings with an anatase structure on conductive substrates [1]. The films were then chemically doped by organic cuprate (Cu) at varying concentrations via photo-deposition and annealed at 300°C in an argon atmosphere. We examine the synergistic effects of surface plasmon resonance and the heterostructure interface on the photoelectric performance of Cu-doped TiO_2 films. UV-Vis spectroscopy confirmed enhanced light absorption in the visible range with increasing Cu concentration, while Raman spectroscopy verified the anatase structure of TiO_2 and indicated shifts in the spectra, confirming successful Cu incorporation [2]. Photoluminescence measurements showed a significant reduction in carrier recombination after doping and electron paramagnetic resonance revealed the presence of oxygen vacancies [3][4].Photocurrent analysis further demonstrated that optimal Cu doping in TiO_2 anatase films enhances photon-to-electron conversion efficiency by enhanced light absorption and minimized photoexcited charge recombination.

Abstract No. 0303 Han-Pin, Hsieh

In this study, tortuosity and porosity are important factors for the all-solid-state battery performance because tortuosity and porosity can affect the ion transport path in composite cathode. The pressure we press on the composite cathode can lower the tortuosity and porosity which means it can improve the all-solid-state battery performance. This study uses polymer solid state electrolyte coating on the active material then use the impedance spectroscopy in symmetric cell to define the ionic resistance. At NSRRC, we use TPS 31A1 technique to reconstruct the 3D structure on the composite cathode, therefore we can analysis the porosity for composite cathode. The ion resistance and the porosity which is dependent on the Mac Mullin numbers can define the tortuosity. The results confirmed that the tortuosity and porosity on the composite cathode has distinctive features on all-solid-state battery.

Abstract No. 0304 Chun-Hao Chang

The increasing proliferation of third-generation semiconductor SiC products has led to the emergence of SiC powder as an industrial byproduct. To reutilize the SiC efficiently, we propose a facile method for fabrication of photocatalytic plates from reclaimed SiC. Our approach involves affixing the SiC onto a glass surface with laser cladding, followed by sputter deposition of a gold film and laser annealing. The resulting nanogold-coated SiC plate exhibited enhanced photocatalytic activity due to the injection of hot elections into the SiC via surface plasmon resonance. Unlike chemical reduction, which requires hours for the synthesis, purification, and isolation of Au/SiC, our approach accomplished this in just 30 minutes. When illuminated, the Au/SiC plate generated electron-hole pairs that formed radicals in the presence of water and oxygen, leading to the decomposition of methylene blue. Furthermore, the Au/SiC plate can be integrated into a microfluidic device for enhanced degradation rate and efficiency. This research provides a simple and environmentally friendly approach to the production of photocatalytic plates from reclaimed SiC and contributes to sustainable development.

Abstract No. 0305 Soorathep Kheawhom

This presentation will highlight the latest progress in enhancing nonaqueous zinc-ion batteries (NZIBs) by incorporating ammonium cations (NH_4^+) as a preintercalant into manganese dioxide (MnO2) cathodes. MnO2-based cathodes are promising for large-scale energy storage systems, but challenges like charge disproportionation limit their efficiency. By preintercalating $NH4^+$ ions, we demonstrate a novel approach to overcome this limitation. Utilizing a wet dimethyl sulfoxide (DMSO) electrolyte, we achieved significant improvements in the charge storage capability of MnO2, raising the specific capacity to approximately 247 mAh/g. Advanced in situ characterization techniques, including synchrotron X-ray diffraction (XRD) and X-ray absorption spectroscopy (XAS), revealed that $NH4^+$ cations form robust hydrogen bonds (NH−O−Mn) within the MnO2 structure. This bonding stabilizes the MnO6 octahedra during charge/discharge cycles, minimizing the distortion that typically reduces charge-storage efficiency. Additionally, the $NH4^+$ preintercalation leads to superior cycling stability, with capacity retention of 85% over 500 cycles. The integration of $NH4^+$ ions enhances ion diffusion and surface kinetics, making Zn2+ insertion more efficient and shifting the reaction mechanism away from proton-based processes. These findings not only improve the practical application of MnO2-based zinc-ion batteries but also open new avenues for designing cathode materials for high-performance energy storage systems. This work represents a significant step toward developing next-generation rechargeable batteries for sustainable and large-scale energy storage solutions.

Abstract No. 0306 Thao Nguyen

In this work, we present an effective method to fabricate a freestanding composite electrode for lithium-ion batteries by dispersing carbon nanotubes (CNTs), silicon (Si), and graphene oxide (GO) in an aqueous solution followed by vacuum filtration.[1] Notably, chemically reduced CNT/Si/rGO-5%-Chem anodes demonstrate superior mechanical durability compared to their thermally reduced counterparts. The chemically reduced anodes exhibit remarkable flexibility, whereas thermally reduced anodes suffer from weakened mechanical strength, leading to wrinkles and fractures. This chemical reduction process also enhances electrochemical performance. The long-term cycling stability of the non-reduced CNT/Si/GO 5% composite anode is significantly improved by chemical reduction, increasing its capacity from 1,461 mAh g^{-1} to 2,342 mAh g^{-1}. Electrochemical impedance spectroscopy (EIS) reveals that chemically reduced anodes exhibit a lower initial charge transfer resistance (148 Ω) compared to thermally reduced anodes (172 Ω). After cycling, the chemically reduced anode shows a lower solid electrolyte interphase (SEI) resistance (43 Ω), as opposed to 72 Ω in the thermally reduced anode, indicating reduced electrolyte decomposition. Furthermore, the charge transfer resistance of the chemically reduced anode remains 15% lower than that of the thermally reduced anodes after cycling, indicating more efficient ion and electron transport. The composite structure adapts during cycling, supporting smooth ionic and electronic conductivity, which improves the utilization of active materials. In conclusion, these findings underscore the advantages of chemical reduction in enhancing both the mechanical integrity and electrochemical performance of the self-standing CNT/Si/rGO composite anode, making it a promising candidate for high-performance lithium-ion batteries.

Abstract No. 0307 Thi Ai Ngoc Bui1

Lithium-sulfur batteries (LSBs) have emerged as a promising alternative to traditional lithium-ion batteries, which offers higher energy density and theoretical capacity. However, their widespread adoption has been hampered by several inherent challenges, including inefficient sulfur utilization, the dissolution of lithium polysulfides (LiPSs), and rapid capacity deterioration. To address these issues, this study developed an innovative approach involving a modified separator coated with reduced graphene oxide and carbon nanotube (rGO/CNT) microspheres. This novel cell configuration aimed to improve electron transfer, restrict LiPSs to the cathode region, and prevent their migration to the anode. The rGO/CNT-modified separator has demonstrated remarkable performance, with an initial capacity of 1482 mAh g−1 and a minimal capacity decay rate of 0.09% per cycle. The highly conductive nature of the rGO/CNT coating enhances the utilization of active materials. Even under high-rate conditions, rGO/CNT substantially increases the capacity up to 824 mAh g−1 at 4C. Moreover, the modified separator exhibits an impressive capacity of 895 mAh g−1 with a high sulfur loading of 4.8 mg cm−2, maintaining long-term cycling stability. These results indicate that the rGO/CNT-coated separator significantly improves sulfur reutilization, mitigates capacity decay, and enhances the overall electrochemical stability of LSBs. By simplifying the manufacturing process and offering a practical solution to overcome the inherent limitations of LSBs, this innovative approach brings LSBs closer to commercial viability and widespread application.

Abstract No. 0308 彭啓恩

This study introduces a novel and economical high-concentration aqueous electrolyte for asymmetric supercapacitors. The electrolyte is created by blending potassium acetate and potassium carbonate to produce a water-in-salt (WIS) electrolyte. Through manipulation of the salt molar ratio, this electrolyte attains a wider electrochemical stability range, enhanced conductivity, decreased viscosity, and improved flame retardant properties. The electrolyte solution supplies an abundance of OH^- ions necessary for reactions at both electrodes, providing a safe and innovative option. A nickel-cobalt layered double hydroxide (NiCo-LDH) was created using hydrothermal methods and then further optimized through reflux to enhance its porosity, thereby improving ion access and capacitance. Additionally, a goethite composite (α-FeOOH/rGO) was synthesized through hydrothermal methods, in which reduced graphene oxide (rGO) was used to enhance cycling stability and capacitive performance. The use of these materials and an 11.375 m WIS(61:30) electrolyte in an asymmetric supercapacitor resulted in a specific capacity of 61.64 mAh/g at 1 A/g. Even at 10 A/g, it maintained 27.22 mAh/g, demonstrating strong rate performance. After 5,000 cycles at 2 A/g, it retained 42% of its initial capacity. The device achieved a power density of 852.57 W/kg and an energy density of 52.55 Wh/kg at 1 A/g, operating effectively down to -20°C. The WIS electrolyte offered superior voltage range, coulombic efficiency, capacitance, and temperature tolerance compared to conventional 1 M KOH electrolytes.

Abstract No. 0309 蔡承紘

This study explores the treatment of TiO2 nanorod arrays with varying concentrations of NaBH4 to modify the defect structure of the TiO2 photoelectrode[1]. We investigate the impact of these defect modifications on photogenerated current response and the degradation of methylene blue and methyl orange dyes under light irradiation. Our results show that TiO2 nanorod arrays treated with 0.5 M NaBH4 exhibit a significantly reduced electron-hole recombination rate, as evidenced by photoluminescence spectra, and achieve a photocurrent of 102 μA/cm2 under xenon lamp irradiation (UV and visible light), a marked improvement compared to the 26 μA/cm2 observed in untreated samples. In terms of organic dye degradation, nanorods treated with 0.1 M NaBH4 demonstrated superior adsorption performance during dark adsorption experiments, likely due to the formation of Ti3+ species and the introduction of oxygen vacancies[2], which enhance the adsorption of positively charged methylene blue molecules[3]. Ongoing work is focused on validating these mechanisms.

Abstract No. 0310 **Mengyao Gao**

The traditional use of alkaline water electrolysis for hydrogen production faces significant technical challenges, primarily due to the difficulty in obtaining efficient catalytic electrodes that exhibit both very low overpotentials and long-term durability at ultra-high current densities (≥1 A cm−2). This study is inspired by nature and utilizes carbonization treatment of protein-rich biowaste, cleverly enabling in-situ nitrogen doping within the carbon framework. Through an activation process, the material develops a hierarchical porous structure rich in nitrogen atoms. Additionally, we further combine the biowaste-derived porous carbon material with nickel-iron metals, employing three-dimensional nickel foam as a support to firmly weld the active materials onto the nickel foam. This approach enhances the inherent activity of the active sites and synergistically promotes hydrogen evolution reaction (HER) in alkaline electrolytes.

Abstract No. 0311 **Jing-Xian Chen**

The rapid development and application of lithium-ion batteries (LIBs) have resulted in the generation of a large number of discarded LIBs. Spent LIBs (sLIBs) are a valuable waste due to the presence of high-value metals. Without proper recycling, they can cause environmental pollution. With the global imperative to achieve net-zero emissions to address rising temperatures, the current understanding of LIBs recycling remains limited. Currently, pyrometallurgical and hydrometallurgical methods are the most mature approaches for recycling LIBs, each with its own disadvantages. Therefore, repurposing sLIBs as catalysts for hydrogen production via water electrolysis while simultaneously recovering metals could be a potential solution. In this study, we extract black mass from discarded LFP (Lithium Iron Phosphate) cathodes and use it to coat nickel foam, enabling hydrogen production, and explore a method to simultaneously produce hydrogen and recover high-value lithium metal. The focus of this study is to enhance the performance of the hydrogen evolution reaction (HER). Once the performance is successfully improved, the next step will be to investigate how to recover lithium metal using a green method.

Abstract No. 0312

Shao-Yang Wu

Background: Conductive poly(3,4-ethylenedioxythiophene) or PEDOT emerges as an ideal mediator in fabricating electrochemical sensors. Concurrently, porous metal-organic frameworks (MOFs) present intriguing characteristics such as sufficient surface area, stable structures, and alterable surface ligands. The combination of these two materials in fabricating sensors has started to gain significant attention.

Methods: We investigated the effectiveness of employing Fe-based MOF or MIL-100(Fe) in conjunction with a PEDOT-modified Pt electrode for detecting the synthetic azo dye tartrazine, which is commonly used in food coloring. Our investigation encompassed two distinct approaches. Initially, we immobilized MIL-100(Fe) to the PEDOT/Pt electrode during the electrochemical synthesis of the PEDOT film. Subsequently, we pursued the attachment of MIL-100(Fe) onto the surface of the synthesized PEDOT film by applying positive or negative potentials.

Significant Findings: We have achieved favorable lower reductive potentials, competitive sensitivities, remarkable repeatability and stability for all MIL-100(Fe)/PEDOT/Pt electrodes. Interestingly, we observed the transformation of MIL-100(Fe) into a flower-like structure under -1 V potential while immobilizing on PEDOT/Pt. This structural alteration led to an approximately twofold amplification in sensitivity for tartrazine detection, reaching 1.818 μA/μM. These findings clearly indicate the potential synergies between MIL-100(Fe) and PEDOT for the fabrication of electrochemical sensors.

Abstract No. 0313 Manunya Okhawilai

Zn ion batteries (ZIBs) are encouraging for future energy storage applications due to their cost-effectiveness, mild electrolyte systems, and adequate resource supply. Separator is an essential part of all batteries, as it facilitates the movement of ions and, concurrently, prevent electrical contact between the two electrodes of opposite polarity [1]. It should possess favorable mechanical, thermal properties and dimensional stability. To retain electrolytes and reduce ionic resistance, separator must possess a high porosity and uniform pore size. Electrospinning is a method that can be employed to create a membrane that satisfies these requirements. Commercially available separators are specifically designed for Li-ion batteries, which have an electrolyte that differs from that of ZIBs. Polymer-based separators for ZIBs have been developed to improve the overall efficacy of the battery. Bio-based polyurethane membranes have been fabricated for separators and quasi-solid polymer electrolytes as the world progresses toward a sustainable society and net-zero [2-4]. The results demonstrated exceptional cyclability and excellent ionic conductivities, suggesting that bio-based materials have a significant potential for use in ZIBs.

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Abstract No. 0314 Chih-Ching Kuo

All-inorganic halide perovskites ($CsPbI_2Br$) have attracted considerable attention due to their excellent thermal stability. However, phase instability under ambient conditions and significant open-circuit voltage (Voc) loss remain challenges that need to be addressed. In this study, we employ oxygen engineering strategies and demonstrate that the inclusion of O_2 during the formation of perovskite crystals, which leads to the formation of Pb–O bonds, can prevent the transformation of $CsPbI_2Br$ from the α-phase to the δ-phase. Moreover, once sufficient energy is achieved to form enough Pb–O bonds on the $CsPbI_2Br$ surface, the Voc can increase to 1.3V due to reduced surface defects, which also improves electron transport.

Abstract No. 0315 Cheng-Yan Song

So far, almost all n-i-p structure perovskite solar cells use hole transport layer materials that are doped or contain hygroscopic additives to improve hole mobility and conductivity, such as LiTFSI and t-BP. However, the hydrophilic nature and corrosive effects of these materials can compromise device stability, creating an urgent need to find potential undoped candidates for hole transport layers while ensuring high photovoltaic performance and long-term stability of the solar cells. In this study, D-A copolymers are used as hole transport layer materials in a composite structure, and the interface between MeO-2PACZ and MoO3 is further investigated. So far, the power conversion efficiency has been improved to nearly 22% while maintaining good stability.

Abstract No. 0316 Bing-Chen Gu

This research examines the application of artificial neural network (ANN) models to improve the precision of short-chain fatty acid (SCFA) quantifications in feces through electrochemical methodologies. SCFAs, comprising acetic acid, propionic acid, and butyric acid, are critical biomarkers of gastrointestinal health. Probiotics, primarily composed of lactic acid bacteria, assume a crucial function in human health, while their metabolic byproducts—SCFAs, serve as important indicators of their efficacy. Conventional analytical techniques such as gas chromatography and mass spectrometry (GC/MS) are reliable yet labor-intensive, necessitating intricate sample preparation procedures. Voltammetry employing disposable electrodes presents numerous advantages, including rapidity, cost-efficiency, heightened sensitivity, miniaturization, and portable detection capabilities, thus facilitating the analysis of microsubstances in solution.

This research developed a faster alternative by integrating ANN models with electrochemical techniques. Following the pre-treatment of samples to eliminate contaminants, electrochemical signals were integrated into ANN models utilizing TensorFlow. The models proficiently suppressed background noise and markedly enhanced measurement precision in comparison to conventional multiple linear regression (MLR) models. The ANN model attained R^2 values of 0.996, 0.998, and 0.999 for propionic acid, butyric acid, and acetic acid, respectively, thus surpassing the performance of the MLR models. The ANN model exhibited a robust correlation with gas chromatography-mass spectrometry (GC/MS) results.

Abstract No. 0317 Yen Ju Chu

The advancement of semiconductor manufacturing technology greatly miniaturizes the electronic components. The etching process of photolithography plays a crucial role in semiconductor miniaturization, making the selection of chemical agents critical. Alkaline agents are commonly used for the photoresist removal; however, corrosion of metallic traces is inevitable. Adding corrosion inhibitors into the stripper can protect these metallic traces from corrosion. The corrosion inhibition efficiency is influenced not only by the molecular structures of the inhibitors but also the metal microstructures. To investigate these two factors, corrosion study of copper electroplated films with different microstructures in an alkaline solution, with the addition of either a single or formulated inhibitor, has been conducted. The copper samples are fabricated using electroplating to manipulate the grain size and texture. According to the electron backscatter diffraction (EBSD) analysis, the coarse-grained (CG) copper primarily exhibits crystal growth along the (100) plane, with a grain size of approximately 15 to 20 μm. The submicro-grained (SMG) copper, which has a random orientation, features smaller grain size and more grain boundaries on the surface. The results show that the formulated inhibitor exhibits a higher charge transfer resistance (Rct), indicating that a protective film was formed on the copper surface because of the interaction between inhibitor molecules and metal atoms. Electrochemical tests also show that sputtered copper has better anti-corrosion efficiency than CG copper. The electroplated copper microstructure was characterized using X-ray diffractometer (XRD) and EBSD. Electrochemical analysis, mechanical dynamic simulation, scanning electron microscopy (SEM), and X-ray photoelectron spectroscopy (XPS) techniques were employed to explore the inhibition mechanism of formulated inhibitors for metal corrosion.

Abstract No. 0318 Chih-Yu Lin

Phenolic compounds are widely used in industrial processes but also pose significant risks to the environment and human health. Therefore, a highly selective and sensitive electrochemical sensor for the detection of hazardous phenolic compounds, such as hydroquinone, has been successfully developed. The sensor that is fabricated by modifying the surface of a pencil lead with the conductive polymer PEDOT (poly(3,4-ethylenedioxythiophene)) using cyclic voltammetry has shown great promise in the electrochemical detection of toxic chemicals. The use of pencil lead as a substrate also provides a low-cost and readily available platform for sensor fabrication, making the device both affordable and accessible. In this study, experimental results showed that the modified sensor exhibited excellent sensitivity towards hydroquinone with a great stability after multiple measures. Meanwhile, it demonstrated a distinguishing selectivity against resorcinol or bisphenol, we therefore provided an insight into the observation.

Abstract No. 0319 Kazuhiro Shibata

Weavable devices integrate functional electronic fibers into fabric, expanding beyond traditional wearables. Previous studies successfully metallized polymer textiles with high conductivity via electroless plating in supercritical carbon dioxide (sc-CO2) [1,2]. This study aims to conduct metallization of polymer yarns, specifically nylon yarns, with the deposition of Ni-P. Additionally, considering that polymer yarns are often twisted in application, the effects of the twist number will be investigated.

The findings (Table 1) indicated that the electrical resistance of the Ni-P/Nylon composite yarns exhibited variability based on the twist number of the original Nylon yarn, with a notable decrease in the electrical resistance as the twist number increased. To understand the relationship between the electrical resistance of the Ni-P/Nylon composite yarns and the twist number, scanning electron microscopy (SEM) observation were conducted on the Ni-P/Nylon composite yarns (Fig. 1). SEM observations of metallized yarns with varying twist numbers confirmed a proportional increase in Ni-P metal deposition. In conclusion, it is evident that the conductivity of the Ni-P/Nylon composite yarns improved due to the formation of a thicker Ni-P layer as a function of twist number.

Abstract No. 0320 Chao Fang Huang

Designing low-cost, durable, and highly efficient catalysts for oxygen evolution reaction (OER) to produce oxygen is of great importance due to their critical role in the water-splitting process. In this study, low-cost metals such as Fe, Co, Cr, Mn, and Cu were synthesized into a high-entropy alloy, FeCoCrMnCu (FCCMC), through a simple hydrothermal method. The same technique was also used to prepare medium-entropy FeCoCrMn (FCCM) and low-entropy FeCoCr (FCC) alloys. The synthesized materials were characterized using X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), field-emission scanning electron microscopy (FE-SEM), and high-resolution transmission electron microscopy (HR-TEM). The electrocatalytic performance of FCCMC as a catalyst for water oxidation under alkaline conditions was evaluated through linear sweep voltammetry (LSV), Tafel plots, chronopotentiometry, and electrochemical impedance spectroscopy (EIS). The FCCMC material exhibited excellent water-splitting efficiency, achieving a current density of 10 mA cm^{-2} at only 1.42 VRHE with small Tafel slopes, which is superior to other similar materials.

Moreover, the greater stability of the materials was analyzed by chronopotentiometry for 24 h at a constant current density of 10 mA cm-2. The turnover frequency (TOF) of the FCCMC has a higher value than other similar materials. Therefore, this study identifies the synthesized FCCMC composite as a highly competitive catalyst for oxygen evolution in alkaline media during water splitting

Abstract No. 0321 **Bo-Chih Huang**

As the global economy grows and the imperative to mitigate environmental impacts from fossil fuels intensifies, supercapacitors (SCs) have emerged as vital energy storage solutions. SCs are esteemed for their high charge-discharge efficiency, exceptional power density, reliability, and long lifespan. The advancement of advanced electrochemically active materials with greater energy storage potential is crucial for future energy storage applications.Nickel selenides have garnered attention for their remarkable electrochemical properties, particularly in supercapacitors. These materials enhance conductivity, reaction rates, and charge transfer through the synergistic effects of nickel and selenium. $Ni_{0.85}Se$, in particular, enables rapid charge storage and release, showcasing superior energy storage capabilities. Meanwhile, $NiSe_2$, with its unique structure and chemical stability, delivers excellent electrochemical performance, providing high power and cycle stability in supercapacitors. The study utilized a simple pulse-reversal (PR) electrodeposition method to successfully create nickel selenide nanostructures on carbon nanotubes (CNTs). By reducing the PR potential from 0.2V to -0.2V, the formation of nickel selenide nanostructures was effectively controlled, resulting in a composition shift from $NiSe_2$ to $Ni_{0.85}Se$. The CNTs@$NiSe_2$ electrode exhibited excellent performance, achieving a specific capacity of 125.4 mAh g^{-1} at 2 A g^{-1} and retaining 81.2% capacity at 16 A g^{-1}. Furthermore, the hybrid supercapacitor, using CNTs@$NiSe_2$ as the cathode, demonstrated outstanding energy storage performance, reaching a specific capacity of 42 mAh g^{-1} at 1 A g^{-1} and a maximum energy density of 33.6 Wh kg^{-1} at 800 W kg^{-1}..

Abstract No. 0322 **曾楷祐**

The rapid development of portable electronics and emerging electric vehicles has created a pressing need for electrical energy storage systems. Among these systems, rechargeable zinc-air batteries (ZABs) have emerged as a compelling candidate due to their high theoretical energy density of 1218 Wh k-1, coupled with inherent safety features, cost-effectiveness, and environmental sustainability.In this study, we introduce a straightforward one-step electrochemical pre-treatment method aimed at enhancing the functionality of both the commercial GDL and the catalyst.Comparing air cathodes that underwent pre-treatment (activated ZAB, denoted as ac-ZAB) with those that did not (original ZAB referred to as o-ZAB), within a chloride-based near-neutral electrolyte environment. Cyclic voltammetry testing highlighted the enhanced bifunctional catalytic efficiency of Ru0.7Sn0.3O2, with ac-ZAB showing stronger cathodic ORR and anodic OER signals in comparison to the o-ZAB. Furthermore, the galvanodynamic discharge curve along with its power density curve revealed that the ac-air has a much higher power density of 38 mV cm-2, surpassing the o-ZAB (15 mV cm-2). It is noteworthy that ac-ZAB exhibits much smaller activation polarization in comparison to o-ZAB, indicating the effectiveness of the pre-treatment. In long-cycle galvanodynamic charge-discharge tests, the ac-ZAB showcased improved performance, demonstrating lower charging voltages and higher discharging voltages (1.98 V and 1.15 V, respectively), resulting in a reduced voltage gap of approximately 0.83 V. The battery incorporating ac-ZAB also exhibited remarkable stability, maintaining performance over 10 days. These outcomes underscore the pre-treatment's ability to significantly boost bifunctional oxygen electrocatalytic activity, surpassing untreated counterparts and setting new benchmarks in the field.

Abstract No. 0323 Yu-Ze Chen

Aqueous zinc-ion batteries (AZIBs) have gained considerable attention due to their safety, cost-effectiveness, and environmental friendliness. However, challenges such as hydrogen evolution reactions and the growth of zinc dendrites have negatively impacted Coulombic efficiency and battery lifespan[1-2]. In this talk, to address these challenges, this research focuses on interface engineering, specifically by designing 3D-structured current collectors and applying alloying and texturing techniques to the surface of zinc metal. These innovations effectively suppress dendrite formation and extend battery life, significantly improving the performance and durability of aqueous zinc-ion batteries. This talk uncovered 3 topics: (1) A novel 3D finned structure was developed on Zn metal (2) Standing 2D δ-Cu2Te flakes (δ-CTFs) served as the current collector to accommodate Zn for AZIBs. (3) Synthesizing zincophilic ZnTe directly on zinc (denoted as ZnTe@Zn) as a protective layer demonstrates a low nucleation energy barrier (48 mV) and exhibits high electrical and ionic conductivity (1.9×10^{-5} S cm^{-1} and 6.8×10^{-5} S cm^{-1}, respectively).

Abstract No. 0324 Ting-Li Fang

Expanded graphite (EG) has a wide range of applications (e.g., batteries, supercapacitors, and sensors) and is normally prepared with chemical intercalation and thermal expansion methods [1]. In the preparation of graphite intercalation compound (GIC), electrochemical intercalation can be used to replace the chemical intercalation for reducing the use of chemicals and shorten the reaction time [2]. Moreover, microwave-assisted expansion is usually used to substitute the thermal expansion in order to prepare EG more efficiently. This study aimed to prepare GIC using an electrochemical intercalation method with diluted H2SO4 solutions and to convert GIC to EG via a microwave-assisted expansion process. The reaction parameters of electrochemical intercalation included current density (100–240 mA/cm2), reaction time (1–120 min), and concentration of H2SO4 (20–60%), and the examined microwave conditions were power (200–800 W) and irradiation time (3–120 s). In this study, the most appropriate parameters of electrochemical intercalation included a current density of 240 mA/cm2, a reaction time of 15 min, and 60% H2SO4 solution. During repeated experiments, the metal irons continuously released from stainless-steel electrodes to the liquid phase, thus affecting the intercalation reactions. The specific surface area of EG increased with increasing microwave power and irradiation time. In contrast, the EG with the largest expanded volume (289 mL/g) was obtained by using microwave-assisted expansion at 500 W for 60 s.

Abstract No. 0325 **Varad Modak**

The process of electrocatalytically reducing carbon dioxide (CO2) into valuable fuels and chemicals has gained significant focus as an environmentally-friendly strategy to address greenhouse gas emissions and generate renewable energy sources [1]. In this study, we present a novel electrocatalytic system comprising nickel single atom catalyst (Ni-SAC) sites uniformly dispersed within porous carbon nanofibers (Ni-CNFs) doped with S atoms, for the selective electroreduction of CO2. The synthesized Ni-CNFs exhibit a remarkable electrocatalytic performance, manifesting a current density of 200 mA/cm2 (at -0.8V vs. RHE). The S-doped Ni-CNFs display an impressive Faradaic Efficiency for CO production exceeding 95%, across a wide working potential range of -0.2 to -1V vs. RHE, affirming the exceptional selectivity of the Ni-SACs. The atomically dispersed nickel species facilitate the suppression of the competing hydrogen evolution reaction (HER) [2], yielding a highly specific electrocatalytic process. The incorporation of S heteroatoms within the porous matrix of the carbon nanofibers contributes to enhanced catalytic activity, due to charge imbalance and excess electron density [3,4]. These sites thus provide highly active centers for CO2 adsorption and conversion. The extended potential window demonstrates the catalyst's versatility and effectiveness under varying operating conditions. The synergistic combination of atomically precise catalyst sites and heteroatom doping underscores the potential of chemically tailored porous carbon nanofibers hosting Ni-SACs, as a viable platform for efficient CO2 electroreduction.

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Abstract No. 0326 **Ze-Ren Jhang**

To address the increasing demand for clean energy and the growing market for various electronic devices. Thick electrodes hold great potential for high-energy battery systems, but they face challenges with limited lithium-ion transport kinetics due to extended diffusion paths and complex transport routes. While the chemistry modification may enhance the intrinsic electrochemical properties of active materials, electrode architecture design offers greater versatility across a wide range of material chemistries. Electrodes with adequate thickness is still hindered by slow electrochemical kinetics caused by tortuous pathways/channels for Li+/e- transport in high tortuosity electrodes. Although new low-tortuosity designs are emerging, maintaining capacity at higher current densities remains a challenge. In this work, using the freeze-drying technique enables the synthesis of arrangement pore structure. Various porous LTO electrodes was fabricated based on partial densification with different microstructures were obtained. Then the electrodes still underwent a high-temperature densification process to achieve adequate particle adhesion and an increase of areal capacity density. This study indicates that the thickness and pore structure of the electrode have an impact on the ionic and electronic conducting paths, as well as on the electrochemical performance of the battery. The prepared LTO anode were characterized by X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Electrochemical Impedance Spectroscopy (EIS), Cyclic voltammetry measurement (CV) and discharge-charge tests of the batteries for crystallization, particles morphology, impedance analyses and electrochemical performance.

Abstract No. 0327 Chieh-Lin Chiang

Formic acid is a versatile substance with significant potential as both a fuel and hydrogen storage material, making it a highly promising energy source. As a hydrogen storage medium, one liter of formic acid can produce an impressive 590 liters of hydrogen under ambient conditions, reflecting its high energy density. When used as a fuel in direct formic acid fuel cells (DFAFCs), it offers several advantages, including higher open-circuit voltage due to the reduced permeability of the polymer electrolyte membrane. Additionally, formic acid's low toxicity and high safety profile further position it as a viable energy solution. To maximize the efficiency of DFAFCs and hydrogen production, high-performance catalysts are essential in promoting the formic acid oxidation reaction (FAOR). These catalysts play a critical role in lowering anode overpotential and preventing poisoning, both of which are vital for optimizing cell performance. However, conventional catalyst testing methods are often time-consuming and resource-intensive. In this study, we address these challenges by employing a substrate collection method based on scanning electrochemical microscopy (SECM) using microelectrodes, allowing for more efficient catalyst screening. Through a combinatorial assembly approach, we developed a Pd-Sn-Ir ternary catalyst array for FAOR. The surface morphology of these catalysts was assessed using SEM, and their composition was measured via energy-dispersive spectroscopy (EDS). Additional structural confirmation was provided by X-ray diffraction (XRD) and X-ray photoelectron spectroscopy (XPS). To gain deeper insight into the kinetics of formic acid oxidation, we conducted a series of electrochemical analyses, including cyclic voltammetry (CV), stripping voltammetry, measurements of diffusion coefficients, charge transfer coefficients, reaction rate constants, reaction order, electrochemical impedance spectroscopy (EIS), and Tafel slope analysis. Our results identified Pd6Sn2Ir2 as the optimal composition for the ternary catalyst, demonstrating outstanding performance in terms of lower overpotential, enhanced resistance to CO poisoning, and significantly improved catalytic activity for FAOR.

Abstract No. 0328 Minjoon Hong

Imidazolium-based room-temperature ionic liquids (RTILs) show promise as electrolytes for zinc-air batteries due to their chemical stability and high ionic conductivity. While experimental performance data for various RTILs exist, the atomistic mechanisms underlying ion transport phenomena remain understudied, primarily due to computational costs and force field development challenges. This study presents a machine learning interatomic potential (MLIP) for imidazolium-based RTILs with four anion species: BF4, PF6, bis(trifluoromethanesulfonyl)imide (TFSI), and trifluoromethanesulfonate (TfO). We fine-tuned the pretrained MACE-MP-0 model using a dataset of 100 distinct configurations sampled from molecular dynamics (MD) trajectories of randomly generated RTIL mixtures. The MD simulations for data generation were performed using MACE-MP-0 potential to accelerate configurational sampling. The resulting MLIP demonstrates excellent generalization to out-of-domain data and accurately predicts RTIL densities. Using the trained MLIP, we performed 300 ps NVT MD simulations for each anion type. Radial distribution function analysis reveals that the primary solvation shell of Zn2+ consists of RTIL anions, which implies Zn2+-anion correlations in Zn2+ ion transport. Further investigation suggests a linear relationship between logarithmic ionic conductivity and Zn2+-cation binding energy, providing insights into the underlying transport mechanisms in these RTIL electrolytes.

Abstract No. 0329 Tien-Chai Lin

Electrochromic materials become important due to the fascinating optical properties such as reversible modulation of the color and variation of transmittance under a small voltage stimulus [1]. Typical ECDs have a sandwich structure with five superimposed layers include the electrochromic (EC) layer, the ions storage layer, the electrolyte, and two transparent conducting layers. For the EC layer, the active cations (Li+) intercalate into the EC layer through a small bias voltage and deintercalation from the EC by a reverse bias voltage.

Vanadium pentoxide, V2O5, drawn scientific attention as an electrochromic ionic storage layer[2] because of its good electrochemical properties. The electrochromic property of cobalt doped vanadium pentoxide deposited by a co-sputtering system is investigated. The electrochromic properties of the device were measured by cyclic voltammetry. The deposition of the power toward V2O5 is constant at 120 W and toward the Co is varied. It is found that the 20 W deposited Co:V2O5 thin film shows a better transparance difference of 19.2 % at 650 nm of wavelength and its charge capacitance is 57.92 F. Further increase the Co doping toward V2O5 film shows degradation in the charge storage and transparency difference. It shows that the Co:V2O5 thin film is potential for the electrochromic device application.

Abstract No. 0330 Ching-Yu Peng

Chromium pollution in wastewater, resulting from industrial discharges or improper treatment, severely affects human health and environmental ecology. Hexavalent chromium Cr(VI) is more toxic than trivalent chromium Cr(III). Effective treatment of chromium in wastewater is thus a critical concern.

An innovative Flow-Electrode Capacitive Deionization (FCDI) system for treating chromium-containing wastewater were thoroughly studied. Four types of flow-electrode materials (AC, hydrothermal synthesized nano Fe3O4 with AC at different ratio 1:2, 1:1, 2:1) were tested and the Fe3O4/AC (1:1) composite material was found to be the most suitable for removing chromium in the FCDI system. The Fe3O4/AC (1:1) composite consisted of 140-160 nm spherical nano Fe3O4 particles distributed on activated carbon, maintaining a spinel crystal structure with a (311) lattice plane. It had a BET surface area of 173.48 m^2/g, with 99% mesopores of the total pore volume, and a specific capacitance of 15.07 F/g (at a scan rate of 1 mV/s).

With 5 wt% Fe3O4/AC (1:1) composite material as the FCDI flow-electrode material, operating in short-circuited closed-cycle (SCC) mode and at 1.6 V, the FCDI system achieved an average salt removal rate (ASRR) of 0.92×10-4 mmol/min/cm^2, a high charging efficiency of 64.84%, and a low energy consumption of 1.02 kWh/mol, highlighting the potential of hydrothermally synthesized Fe3O4/AC (1:1) composite material for chromium removal from wastewater.

Reusing 5 wt% Fe3O4/AC (1:1) composite material for FCDI also demonstrated effective chromium removal, with a slightly increased ASRR from 0.92×10-4 to 1.04×10-4 mmol/min/cm^2. However, the charging efficiency significantly decreased from 64.84% to 38.24%, and energy consumption increased from 1.02 to 1.89 kWh/mol, indicating that Fe3O4/AC (1:1) composite material can be cleaned and reused, but further research is needed to assess its long-term reuse feasibility.

In the presence of anions at the same molar concentration (6.8 mM) with chromate ions, SO4^{2-} had a more pronounced negative impact on the removal of negatively charged chromate ions compared to Cl$^-$ or NO3$^-$. When SO4^{2-} coexisted in the chromate solution, ASRR significantly dropped 27% from 0.92 × 10-4 mmol/min/cm2 to 0.68 × 10-4 mmol/min/cm2.

Abstract No. 0331 Yonghak Park

Platinum (Pt) is known for its high catalytic efficiency in the hydrogen evolution reaction (HER), but its scarcity and high cost have prompted the search for alternatives that reduce Pt usage without sacrificing performance. One promising approach is alloying Pt with earth-abundant elements and doping with other elements to adjust the electronic structure and enhance catalytic activity.

In this study, we propose a Pt-Zn alloy catalyst doped with phosphorus (P) and bismuth (Bi), offering both reduced Pt content and improved HER activity. Using first-principles calculations, we identified the stable structure of the PtZn alloy and determined the optimal doping configurations for P and Bi. We also calculated the adsorption energies of key intermediates and constructed a reaction free energy diagram, which validates the improved catalytic performance of the doped alloy. Through a detailed analysis of the electronic structure, we found that P and Bi doping not only stabilizes the catalyst but also modifies the electronic properties at active sites, enhancing HER activity. Our study highlights a viable pathway for designing cost-effective and efficient Pt-based catalysts for electrochemical applications.

Abstract No. 0332 李元堯

The recently developed rechargeable lithium-chlorine (Li-Cl2) batteries have attracted significant attention due to their high energy density, elevated operating voltage, and extensive temperature tolerance. In this study, a microporous biomass-derived activated carbon (AC) with an ultra-high specific surface area (3672 m2 g-1) and a high pore volume (2.67 cm3 g-1) was prepared from rice straw (RS). The Li-Cl2 batteries were assembled using RS-AC as the active material, with LiAlCl4 or AlCl3 as an additive in the electrolyte. The developed battery exhibited an outstanding initial discharge capacity of 3625 mAh g-1 at a current density of 150 mA g-1. Moreover, it demonstrated stable cycling performance with 240 cycles at a current density of 1000 mA g-1 and a capacity of 1200 mAh g-1. The remarkable specific surface area, pore characteristics, and pore volume of RS-AC facilitate ample storage capacity for redox products, thereby enhancing both specific capacity and cycling stability of the batteries. A first-principle density functional theory study underscored the impact of functional groups on the performance of Li-Cl2 batteries with RS-AC. These accomplishments contribute to the outstanding performance exhibited by the Li-Cl2 battery in this study.

Abstract No. 0333 **Ha-Phuong Ngo Thi**

In recent years, plastic perovskite solar cells (PSCs) have attracted significant interest because of their lightweight and flexible characteristics, which render them suitable for use in portable and wearable electronics. This study emphasizes progress in the development of electrodeposited TiO2 as a porous thin-film electron transport layer for perovskite solar cells. The electrodeposition technique demonstrates significant effectiveness in perovskite solar modules, especially in scenarios where spin coating is not ideal for large-area film applications. This approach opens the door to scalable, efficient PSC production. The process demonstrates that TiO2 can be synthesized at temperatures below 180°C while maintaining excellent photovoltaic performance, an essential feature for compatibility with plastic substrates. Through careful optimization of fabrication conditions and thorough characterization of device parameters, we achieved a notable power conversion efficiency of 19.1% in plastic PSCs incorporating electrodeposited TiO2.

Abstract No. 0334 **Shun-Yu Tsai**

Chemical Mechanical Polishing (CMP) is a critical step for planarization purposes in semiconductor manufacturing technology. Successful implementation of CMP relies on a slurry consisting of a mixture of abrasives and additives. After the CMP, the used slurry is discarded. With rising concerns over carbon footprint reduction and environmental sustainability, the recycling of used CMP slurry has become an issue. In this work, we adopt an electrophoresis technique to recover alumina and silicon carbide from the used CMP slurry. Electrophoresis entails the imposition of an electric field that drives the movement of suspended charged particles to the electrode with opposite polarity. Since the alumina and silicon carbide in used CMP slurry carry different magnitudes of surface charges, they could be physically separated in a specially designed electrophoresis cell. In our process, we first verify the feasibility of separating alumina from silicon carbide by designing a smaller-scale tank. Subsequently, a larger electrophoresis cell leveraging the combined force of horizontal electrophoresis and vertical gravity-induced sedimentation is used to separate alumina and silicon carbide. The separated particles are further validated for reuse as a fresh CMP slurry component.

Abstract No. 0335 **Bai Tai Liu**

With the growing demand for lithium batteries, developing separators with enhanced safety and stability is crucial. Electrospun fibers, particularly PAN/PVDF blends, have garnered attention for their excellent pore structure and mechanical strength, making them promising candidates for lithium-ion battery separators. This study aims to evaluate the electrochemical performance of electrospun PAN/PVDF fibers as separators in NCM811 lithium half-cells, focusing on their pore structure, swelling behavior, and interfacial dynamics.

To achieve this, we employed a combination of in-situ and conventional electrochemical impedance spectroscopy (EIS) along with scanning electron microscopy (SEM) to analyze the microstructure of the separators, their interaction with the electrolyte, and the dynamics of the solid-liquid interface. FESEM images (as shown in Fig 1.) clearly depict the microstructure of pure PAN fibers, while Fig 2. compares the structural features of the PAN/PVDF blend fibers, demonstrating superior porosity while maintaining excellent mechanical strength. The results provide important insights for optimizing separator performance to enhance the efficiency and longevity of lithium-ion batteries.

Abstract No. 0336 **Chang-Ming, Wu**

Due to the impacts of global climate change and the finite nature of fossil fuel reserves, there has been a growing interest in transitioning to hydrogen energy sources as a potential solution to these challenges. Among the various hydrogen production methods, polymer electrolyte membrane water electrolysis (PEMWE) has gained considerable attention for its high power density and its suitability for integration with intermittent but high-intensity power inputs from renewable energy sources. However, the oxidative and acidic conditions at the anode limit the selection of anode catalysts, where iridium-based catalysts is one of the few durable options capable of sustaining the oxygen evolution reaction (OER) over extended periods. These noble metal-based electrocatalysts represent a substantial portion of the high system cost associated with PEMWE.

In this study, we propose a novel porous transport electrode (PTE) design, where iridium is deposited via pulse-electrodeposition onto an acid-stable tungsten wire mesh. The tungsten metal within the wire serves as an efficient electron transport channel, significantly reducing overall resistance. Concurrently, the tungsten oxide on the surface stabilizes the catalyst through strong catalyst-support interactions, thereby enhancing the activity of the iridium catalyst. OER testing demonstrates that this design achieves high mass activity (6656 A/gIr @ 1.8VRHE) at an ultralow loading (0.036 mgIr/cm^2). Post-mortem XPS analysis reveals charge transfer between the iridium catalyst and the tungsten support, indicating robust metal-oxide–metal-oxide interactions. This strong catalyst-support interaction effectively mitigates the over-oxidation of the iridium catalyst during the OER.

Abstract No. 0337 Teng-Hao Chen

Organic-based electrodes are considered to be more eco-friendly and sustainable than their inorganic counterparts. Hydroquinone can reversibly undergo a 2e–, 2H+ transfer to give p-benzoquinone. Herein, we use a hydroquinone-based organic building block, 1,4-dicyano-2,3,5,6-tetrahydroxybenzene (LH4), to prepare a series of benzoquinoid coordination polymers (CPs) and porous materials as cathode materials for lithium-ion batteries (LIBs). The one-dimensional (1D) CP [CuL(Py)2]n (Py = pyridine) exhibits that the supramolecular interactions between its close-packed chains are the key to the flexible host lattice, which only allows desolvated Li+ to intercalate.[1] The weak bonds also stabilize the inserted Li in the preferred hopping sites, creating optimal diffusion paths. The three-dimensional (3D) metal−organic framework [Cu4L3]n reveals the unique mixed valency in MOFs, formal Cu(I)/Cu(III).[2] The coordination between the mixed-valence metal and redox-non-innocent ligand L, which promotes through-bond charge transfer between Cu metal sites, allows better metal-ligand orbital overlap of the d- conjugation, leading to strong long-range delocalization and semiconducting behavior. The insight gained from this electrode material is valuable for the rational design of 3D MOFs with intrinsic electronic conductivity and multielectron redox activity.

Abstract No. 0338 Watchareeya Kaveevivitchai

Grid-scale energy storage is emerging as one of the largest potential applications for electrochemical devices and will require abundant, low-cost, ultra-stable electrodes. Organic materials possess many advantages such as low toxicity, sustainability, high redox activity, and chemical/structural tunability toward high energy density. However, to compete with inorganic-based compounds, crucial aspects such as redox potential, capacity, electronic conductivity, and cycling stability need to be improved. To enhance stability and overcome dissolution issues of small-molecule organic materials in various electrolytes commonly used in energy storage devices, we report comprehensive strategies on the material design which promotes favorable supramolecular interactions in the solid state. Highly extended π-conjugation allows facile charge transport and extra-high capacity for ion storage (Li+, Na+, Zn2+, H+) with superior rate capability. Covalently assembled organic frameworks are also promising due to exceptionally high structural stability and easily accessible redox-active sites. These strategies will be highlighted together with density functional theory studies providing proof-of-concept for the development of organic compounds as alternative electrode materials for sustainable energy storage systems with exceptionally high energy density, rate capability, and cycling stability.

Abstract No. 0339 Heng-Liang Wu

The solid-liquid interfacial reactions play a crucial role in controlling the performance and stability of electrocatalysts and battery materials1-4. In situ vibrational spectroscopy techniques such as Raman and surface-enhanced infrared absorption spectroscopy (SEIRAS) have been regarded as the powerful tools for examining the surface-adsorbed intermediates on the solid-liquid interfaces. In this talk, we report on our use of in situ SEIRAS, Raman, and X-ray absorption spectroscopy to investigate the mechanistic insights into the electrochemical CO2 reduction, hydrogen evolution and oxygen evolution. For instance, Cu-based electrodes with different oxidation states result in the formation of various CO intermediates such as COatop and CObridge during electrochemical CO2 reduction. The co-existence of COatop and CObridge corresponds to the selectivity of CO2-to-C2H4 reaction. Also, the bimetallic electrocatalysts are developed for efficient CO2-to-HCOOH and CO2-to-CO conversion processes. We found that the surface-adsorbed COO- species with different binding structures play crucial role in the reduction process. The electronic structures of Cu-based electrocatalysts are associated with the formation of surface-adsorbed intermediates and electrocatalytic properties.

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Abstract No. 0340 Hiroshi Imahori

Light energy conversion occurs ubiquitously in nature, science, and technology. Representative examples include light-to-chemical energy conversion in natural and artificial photosynthesis, photoredox organic reactions, light-to-electrical energy conversion in solar cells and optic nerve circuits, and electricity-to-light energy conversion systems in displays. Efforts to advance the science of these energy conversion systems and drive innovation are increasingly necessary for achieving a prosperous and sustainable society in the future. Within this context, our focus has been on organic solar cells (OSCs) to enhance solar energy conversion efficiency. We have tailored versatile dyes for dye-sensitized solar cells (DSSCs) and donor/acceptor (D/A) molecules for bulk heterojunction (BHJ) OSCs to enhance our understanding of their underlying mechanisms and improve their photovoltaic performance. Specifically, we have revealed the close relationship between molecular structure, film structure, photodynamics, and photovoltaic properties in OSCs. These topics encompass: 1) the inclined geometry of dyes on TiO2, 2) methylene bridge fused structures for DSSCs, 3) robust anchoring groups for DSSCs, and 4) isomer effects of fullerene acceptors, 5) control of aggregation on non-fullerene acceptors (NFA), and 6) model systems for BHJ OSCs.

Abstract No. 0341 Hsisheng Teng

Gel polymer electrolytes have been widely developed in recent years; however, it remains a significant challenge for these electrolytes to simultaneously achieve high rate capability, long cycle life, and enhanced safety. In this study, we address these challenges by combining poly(vinylidene fluoride-co-hexafluoropropylene) (PVdF-HFP) with additive ethoxy(pentafluoro)cyclophosphazene (PFPN). A key technique of this work is the unique interaction between PFPN and PVdF-HFP, promoting polymer entanglement, ultimately leading to the formation of a robust 3D cross-linked structure. This gel structure effectively prevents electrolyte leakage and stabilizes the electrolyte, enabling it to pass a nail penetration test at high capacity and elevated voltage. Additionally, the gel electrolyte allows for excellent electrochemical performance at high voltages. The formation of robust SEI and CEI contributes to superior high-rate performance. These results demonstrate the significant potential of this electrolyte design in achieving high power, long-term stability and enhanced safety for lithium-ion batteries.

Abstract No. 0342 Chun-Wei Chen

“Spin” has recently been reported as an important degree of electronic freedom to improve the performance of electrocatalysts and photocatalysts. In the first part of my talk, I would like to present the manipulation of spin-polarized electrons to boost the photocatalytic CO2 reduction reaction (CO2RR) efficiencies through controlling magnetic doping, chirality, and defect engineering.[1,2] The origin of enhanced photocatalytic CO2RR efficiencies is due to the increased number of spin-polarized photoexcited carriers, resulting in prolonged carrier lifetime and suppressed charge recombination. In the second part of my talk, I would like to present the manipulation of spin-polarized electrons of an electrocatalyst to promote oxygen evolution reaction (OER). Spin selection has been described as a possible way to promote electrocatalytic OER, which involves the process of forming triplet-state O2 from singlet-state species (OH− or H2O). I would like to show our recent results of controlling spin exchange interactions and spin-selected electron transfers of electrocatalysts to enhance OER performance. [3,4] By either applying a magnetic field or controlling magnetic dopants and the chirality of electrocatalysts, the OER performances can be significantly enhanced. Several in-situ analytic techniques, such as in-situ X-ray absorption spectroscopy (XAS) and X-ray emission spectroscopy (XES), were also performed to support the understanding of the fundamental mechanism. Our results suggest that manipulating the spin-polarized electrons and spin-exchange interactions of electrocatalysts and photocatalysts is an effective strategy to enhance their catalytic performances.

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Abstract No. 0343 **Hong-Kang Tian**

Lithium-ion (Li-ion) batteries, crucial for energy storage in electric vehicles and renewable energy systems, face efficiency challenges due to lithium (Li) metal dendrite formation on their negative electrodes. These dendrites lead to short-circuits, reduced charging rates, and safety hazards like fires and explosions. The lack of effective solutions for dendrite suppression is attributed to a limited understanding of their formation mechanism. In contrast, magnesium-ion (Mg-ion) batteries exhibit fewer dendrite problems. This study aims to identify the factors causing differing dendrite behaviors in Li-ion and Mg-ion batteries. We used First-principles density functional theory (DFT) calculations and analyzed the negative electrodes of Li and Mg metals as coated with various solid electrolyte interphases (SEIs), such as Li_2O, Li_2S, LiF, Li_3N, Li_2CO_3, MgO, $MgCl_2$, and $Mg(OH)_2$. This approach considers the instability of pure metal surfaces. We suggest dendrite nucleation and growth on these SEIs occur through electron tunneling. Utilizing the Crystal structure AnaLYsis by Particle Swarm Optimization (CALYPSO) package, we developed interface models for Li/Li-SEI and Mg/Mg-SEI. Our results show Li/Li-SEI interfaces typically form as heterogeneous interfaces, while Mg/MgO interfaces prefer SEI-symmetrized formations, which are energetically favorable. Interfaces between Mg and $MgCl_2$ or $Mg(OH)_2$ are found to be energetically unstable. We introduced "plating energy" to evaluate dendrite formation propensity. Analysis indicated a higher tendency for Li plating on Li_2O compared to Mg on MgO, with Li/SEI interfaces exhibiting lower plating energies. The layered density of states analysis revealed restricted electron flow through $MgCl_2$ and $Mg(OH)_2$ surfaces, inhibiting Mg-ion reduction, in contrast to easier electron flow on Li-SEI surfaces. In summary, our research offers new insights into why Mg dendrites are less common than Li dendrites. Key factors include different SEI compounds, higher plating energy of Mg on MgO(111) surfaces, and limited electron flow through certain Mg SEIs. These properties, absent in Li-SEI compounds, result in significant Li dendrite formation on Li electrodes. Our findings open new avenues for designing SEI compounds in Li-ion batteries to mitigate Li dendrite formation.

Abstract No. 0344 **Yu-Lun Chueh**

Rechargeable metal ion batteries have been widely studied as efficient energy storage systems for portable devices, such as electric vehicles, which have become the trend in the future. Among these candidates, zinc ion batteries exhibit superior advantages because of the abundance of zinc compared with lithium, while the cost of zinc is lower than that of lithium. Moreover, zinc has been characterized by multivalence in an ionic state, which provides approximately three times higher volumetric capacity than lithium. For Zn ion batteries, the uncontrollable dendrite growth and side reactions existed on the Zn anode seriously restrict the cycle stability of zinc ion batteries. In my talk, different strategies on the design of low dimensional materials on the surface metal anode or cathode for high-performance rechargeable Zn ion batteries will be reported. For example, organic hydrophobic polyvinylidene fluoride and inorganic Santa Barbara Amorphous-15 (PVDF-SBA15) hybrids were designed as a surface modification layer to stabilize the Zn anode, leading to an optimized Zn/electrolyte interface with large-scale feasibility. In addition, an alternative electrolyte system based on the deep eutectic solvent (DES), because of their low cost, high stability, biodegradability, and non-flammability, making them optimal candidates for sustainable batteries, was demonstrated. Ex-situ Raman, XPS, and TEM characterization results of the electrodes under different states confirm the reversible alloying conversion and intercalation hybrid mechanism during the discharge and charge cycles for Zn ion batteries. All possible chemical reactions were proposed by the electrochemical curves and characterization.

Abstract No. 0345 **Hsiu–Fen Lin**

"In recent years, sodium-ion batteries have garnered significant attention due to their promising attributes, including high energy density, low production costs, and the abundance of sodium as a raw material. Among the various materials studied for sodium-ion battery cathodes, the layered structure materials have emerged as the important research directions. P2-type materials are characterized by their faster sodium-ion diffusion rates and a broader operating voltage range, making them attractive for applications requiring high power and efficiency. However, the practical application of P2 materials is hindered by issues such as voltage decay and the need for pre-sodiation treatments due to their inherent sodium deficiency, which limits their commercial viability. On the other hand, O3-type materials offer a higher initial capacity and a stable voltage plateau, making them promising candidates for long-term energy storage. However, they suffer from slower sodium-ion diffusion and experience significant volume changes during cycling, which affects their overall stability and performance.

This study focuses on improving the electrochemical performance of both P2- and O3-type cathodes by doping them with various metal elements. These modifications aim to enhance their cycling life, improve rate capabilities, and stabilize their structural integrity, making them more suitable for practical energy storage applications."

Abstract No. 0346 Keying Guo

The COVID-19 pandemic has highlighted the need for rapid and sensitive protein detection and quantification in simple and robust formats for widespread point-of-care applications. We here introduce a modular nanobody-functionalized organic electrochemical transistors (OECT) architecture that enables rapid quantification of single-molecule-to-nanomolar levels of specific antigens in complex bodily fluids. The sensors combine a new solution-processable organic semiconductor material in the transistor channel and the high-density and orientation-controlled bioconjugation of nanobody–SpyCatcher fusion proteins on disposable gate electrodes. They provide results after 10-min of exposure to 5 μL of unprocessed samples, maintain high specificity and single-molecule sensitivity in human saliva and serum, and can be reprogrammed to detect any protein antigen for which nanobodies exist. We demonstrate the use of this highly modular platform to detect green fluorescent protein (GFP), SARS-CoV-2 and MERS-CoV spike proteins, and for the COVID-19 screening of unprocessed clinical nasopharyngeal swab and saliva samples with a wide range of viral loads. The speed, performance and versatility of our nanobody-functionalized OECT, and its compatibility with many sample types, suggest that this biosensor technology can complement or replace a wide range of clinical and non-clinical diagnostic assays for serious diseases including but not limited to COVID-19. Our recent research interests revolve around the development of ultrasensitive medical devices with rapid response capabilities for the early diagnosis of neurodegenerative diseases, specifically Parkinson's disease (PD). Our organic electrochemical transistors (OECTs) integrated with microfluidic systems as cutting-edge biosensing platforms have demonstrated the impressive ability to detect PD-related exosomal protein biomarkers from serum at an attomole level (aM, 10^-18 M). Such sensitivity could contribute significantly to the early detection and understanding of these debilitating diseases.

Abstract No. 0347 Tsan-Yao Chen

This study uses in-situ X-ray diffraction technology to identify the phase change trends induced by the increase in the state of charge (SOC) in the crystal structure of lithium compounds in an aluminum-foil-wrapped battery, consisting of a carbon-silicon oxide composite anode and a nickel-cobalt-manganese oxide cathode. By analyzing this relationship, the effects of various assembly parameters (material processing, active material ratios, and the anode-to-cathode active material ratio, or "N/P ratio") on the battery's charge-discharge cycle life were examined. Three types of carbon materials—MG13-AN, UF-2, and FSN-4 were used for the anode, mixed with different proportions of silicon oxide (SiOx), while the cathode consisted of commercial NMC811 material. The results showed that the larger the C-axis lattice spacing of the carbon material, the higher the affinity for lithium ions and the lower the barriers to ion movement, resulting in a longer cycle life for the battery with a pure carbon anode. However, when silicon oxide active material was added to the anode, carbon materials with high lattice spacing (and thus high lithium affinity) competed with the active material for lithium ions. This competition significantly reduced the conductivity of the carbon material early in the charge-discharge cycle, raising the energy barrier for electrons to reach the active material. This, in turn, increased the probability of irreversible reactions during each charge-discharge process, ultimately reducing the battery's cycle life. The correlation between lithium-carbon phase changes and SOC obtained at different charge-discharge rates further verified the same conclusion. This phenomenon was also confirmed by the changes in the charge-discharge curve and cycle life capacity, supporting the conclusion that the evaluation technique proposed in this experiment can indeed be used to determine optimal process parameters that affect battery lifespan.

Abstract No. 0348 Chun-Chen Yang

Co-less Ni-rich layered cathode materials (Ni > 90%) have been highlighted as promising options for achieving high energy density and cost-effective Li-ion batteries (LIBs). The high nickel content facilitates a high specific capacity (>200 mAh g^{-1}), while the low cobalt content helps lower production costs. However, these Ni-rich cathodes (Ni > 90%) face inherent challenges, such as phase transitions, transition metal dissolution, thermal instability, and microcrack formation, which lead to poor cycling performance and capacity degradation. In this study, a transition-metal concentration gradient approach was implemented in Co-less Ni-rich LiNi0.92Co0.04Mn0.04O2 (denoted as FG-NCM92) using a simple co-precipitation method and a novel Taylor-Vortex reactor (TVR) to mitigates the challenges mentioned above and maintain its simplicity and possibility for industrial-scalable applications. The crystal structure, morphology, composition, elemental distribution, surface properties, transition metal oxidation states, and electrochemical performance of FG-NCM92 were thoroughly analyzed in coin-type half-cells and Pouch-type full-cells. Additionally, phase and structural changes, transition metal dissolution, thermal behavior, and self-discharge characteristics during lithiation/delithiation were extensively examined in FG-NCM92 and non-gradient NCM92 electrodes. The results demonstrated that the FG-NCM92 cathode material comprises Ni-rich core and Mn-rich outer parts with good and compact morphology, well-developed crystal structures, low cation mixing, and a high Li-ion diffusion coefficient. The real-time in-situ analyses of FG-NCM92 cells manifested that during the charging/discharging process, the FG-NCM92 electrodes undergo low degrees of phase transitions, generate low total exothermic heat, and maintain their robust structure by preventing abrupt lattice parameter changes. Importantly, the electrochemical performance of FG-NCM92 material was improved relative to that of as NG-NCM92 one. The charge-discharge test on coin-type half-cell exhibited that the FG-NCM92 delivers the initial discharge capacity of 214.3 mAh g-1 at 0.1C and 167.3 mAh g-1 at 10C with a capacity retention of 84% at 4.3 V, 76% at 4.5 V, 63% at 45 °C after 100 cycles at 1C, and 82% at 4.3 V after 50 cycles at 10C. In contrast, the non-gradient NCM92 sample delivers a low discharge capacity of 211.1 mAh g-1 at 0.1C and 152.6 mAh g-1 at 10C with a capacity retention of only 65% at 4.3V, 61% at 4.5V, 58% at 45°C after 100 cycles at 1 C, and 65% at 4.3 V after 50 cycles at 10C. Moreover, the FG-NCM92//Graphite pouch-type full-cells maintain a stable cycling performance of 88.8% over 300 cycles. Thus, the advanced full-concentration gradient design of Ni-rich cathode materials presents a highly promising approach to enhance electrochemical performance, paving the way for high-energy-density, high-voltage cathodes for next-generation Li-ion batteries.

Abstract No. 0349 Ai Ling Huang

The utilization of lithium metal, whether in an anode or anode-free configuration, represents a highly promising avenue for enhancing the energy density of the existing lithium-ion battery framework. Nonetheless, the uncontrolled growth of lithium dendrites poses challenges to the practical use of lithium metal as an anode due to safety concerns and suboptimal Coulombic efficiency.

In this study, we demonstrate that employing a suitable fiber morphology as a coating on a current collector can effectively facilitate uniform lithium deposition by governing the flux of lithium ions and suppressing the formation of lithium protrusions. Using the electrospinning technique, we showcase the capability to modulate the mechanisms of lithium deposition through variations in the fiber morphology of polyacrylonitrile (PAN). Furthermore, the intersecting fibers at the base of the structure enables the nucleation of larger lithium clusters at the bottom, which is then complemented by the addition of aligned fibers to assist in the homogeneous upward deposition of lithium. This approach aims to achieve the goal of dendrite-free lithium deposition. Such modifications result in PAN@Cu anodes exhibiting Coulombic efficiency of over 95% sustained for more than 160 cycles.

As a result, this study not only presents a rapid and scalable approach for lithium battery production, but also significantly enhances both battery performance and lifespan. Additionally, it provides invaluable insights that have the potential to advance the incorporation of artificial solid-electrolyte interphase (SEI) materials in the realm of lithium batteries.

Abstract No. 0350 Hung-Chun Chen

Cu foils are well known components for industrial applications such as printed circuit boards and Li-ion batteries To meet the requirements of the rapid development of electronic devices and the development of lithium batteries towards high energy density. Thus, the thickness reduction of Cu foils has been desired for resources saving and environmental benignity. However, the warpage and deformation from thinner Cu layers causes problems for positioning and cutting of the subsequent production and processing process. It is obvious that the warping deformation of copper foil is due to the residual stress generated during copper electrodeposition. Although approaches such as heat treatment and reducing the plating rate seem to be effective but not very feasible, other solutions may be still needed. Based on our preliminary study, using appropriate additives may be able to modify the nucleation/growth of copper and then stress-induced deformation may be suppressed in an efficient way. In this study, small amount of polymer additives will be added in the electrolyte and processing parameters such as applied voltage and current density will be varied and monitored. Structural, microstructural and morphological analyses will be performed. As a result, thin Cu foils with low warpage will be demonstrated.

Abstract No. 0351 Martyn McLachlan

Metal halide perovskites (MHPs) are a diverse family of materials that have had a colossal impact in photovoltaic and other emerging optoelectronic devices where they outperform incumbent materials and continue to deliver delivering outstanding performance. The intense volume of active research being carried out on MHPs is driven by their unique properties including their tuneable bandgap, large absorption coefficients, large charge carrier diffusion lengths and charge carrier mobilities combined with their relative ease of synthesis. Unfortunately, the synthetic methods that have been developed for depositing MHPs rely on the use of solvents harmful to human health and the environment, furthermore the synthetic protocols have an intrinsic requirement for multi-component solvent systems and a fundamental need for thermal treatment during processing to ensure the desired phases are prepared.

Here we give an overview of a number of novel synthetic strategies we have been developing in our laboratory aimed at identifying routes for MHPs – thin films, nanocrystals, single crystals – prepared using green solvents and without the need for extensive thermal processing. We will elaborate a novel solvent system and synthetic method for the preparation of size and compositionally controlled MHP nanocrystals. Remarkably our synthesis is carried out using a water-based solvent and is achieved in ambient air and at room temperature. We show the synthesis of size controlled CsPbBr3 nanocrystals with a photoluminescence quantum yield (PLQY) > 60 %a and through anion exchange demonstrate the formation of a range of CsPbX3 (X = I, Br, Cl) nanocrystals that cover an emission range of 450 to 660 nm. Our novel, green solvent offers a clean, scalable and low-cost route for size and compositional control of MHP nanocrystals.

Abstract No. 0352 Che-Ning Yeh

Lithium-sulfur batteries (LSBs) offer high energy density, making them promising candidates for commercialization. However, practical application is hindered by low sulfur loading (<4 mg cm^{-2}) and critical challenges such as poor conductivity, significant volume expansion, and the polysulfide shuttle effect. In this study, we address these challenges by developing an advanced sulfur host material. Specifically, binder-free manganese iron nitrides (Mn-Fe nitrides), synthesized from a bimetallic metal-organic framework (MOF), are integrated into a reduced graphene oxide (rGO) aerogel. The rGO aerogel, with its high porosity and flexibility, accommodates sulfur expansion while reducing the shuttle effect. Utilizing this aerogel as a scaffold, the Mn-Fe nitrides effectively immobilize polysulfides across different states. Additionally, we explore the use of sulfide particles to improve catalytic performance for polysulfide conversion and to serve as polysulfide traps to further mitigate the shuttle effect. Both approaches show potential for significantly enhancing areal capacity and cycle stability in LSBs, advancing their feasibility for practical use.

Abstract No. 0353 Yu-An Shen

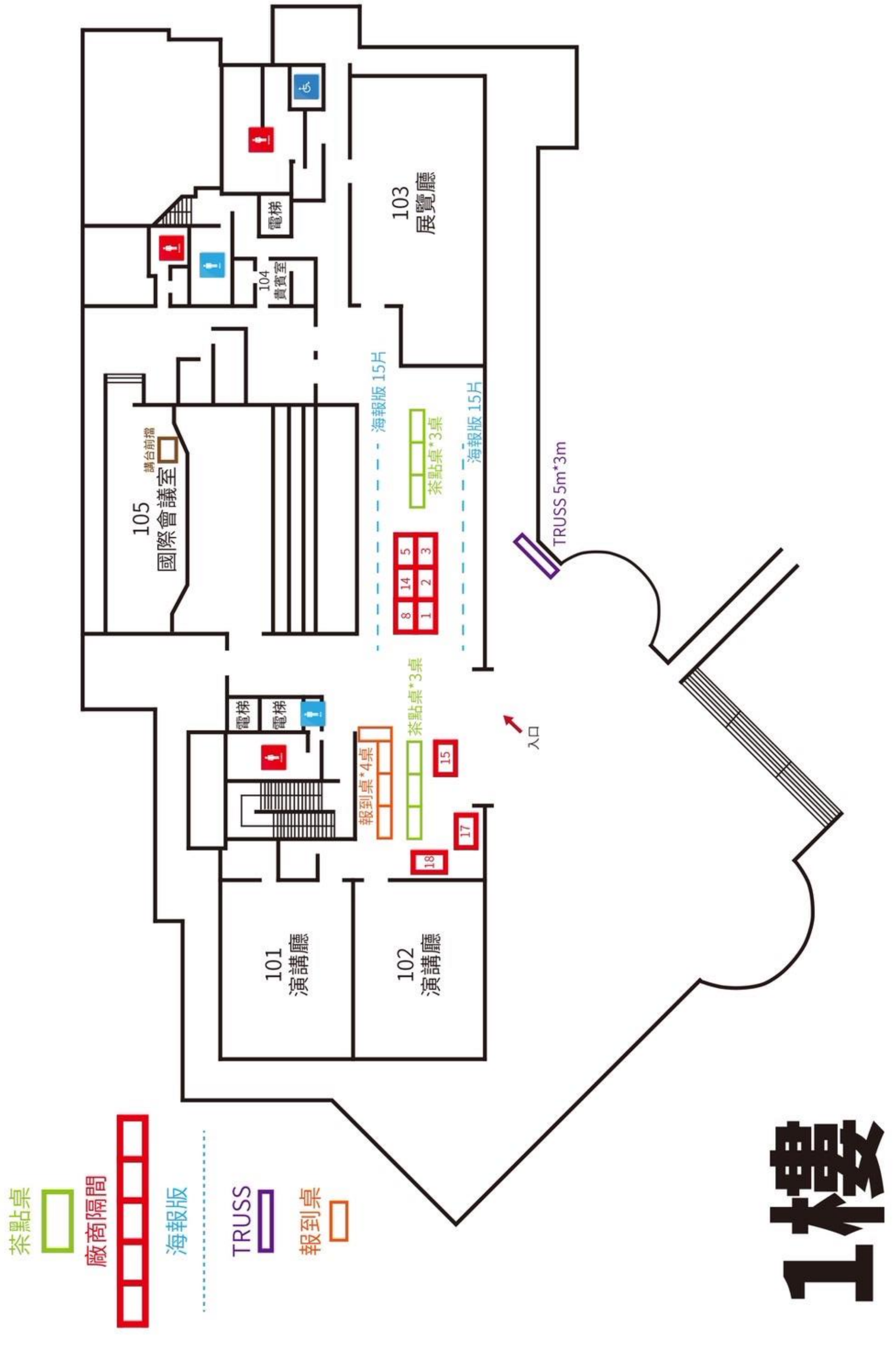
Electroplated copper is a crucial conductive material in advanced electronic packaging. However, in order to achieve electroplated Cu with distinct microstructures (such as nanotwin structures and high aspect ratios), additives are often required in the electroplating solution. These additives, however, frequently lead to the formation of defects at the solder joint interface during the aging process. For instance, Kirkendall voids tend to form at the interface between copper and Sn–3Ag–0.5Cu (SAC305) alloy [1], often leading to a decrease in joint reliability. This study demonstrates that Sn-9Zn (SZ) alloy can effectively suppress interfacial void formation during the aging process, regardless of whether high-impurity or low-impurity copper is used [2]. This suppression is attributed to the different diffusion behaviors of copper in SZ and SAC305. Furthermore, when 5wt.% Bi is added to Sn-9Zn (SZB), it not only maintains a void-free interface but also lowers the melting point of SZ and enhances the alloy's strength and interfacial stability. The mechanisms will be presented to the attendees during the presentation for discussion.

Abstract No. 0354 Kuan-Chieh Huang

The perovskite solar module has been developed for practical applications in CPC Corporation, Taiwan since 2016. The film depositions of such module, featuring fabricaion of device with a large surface area of at least 100 mm × 100 mm, are accomplished using totally vacuum processes. Moreover, the laser scribing technique,

metal masks and encapsulation process are also utilized to assist in the module establishment. Consequently, the module with 100 mm × 100 mm in surface area, consisting of glass, indium tin oxide (ITO), nickel oxide (NiO_x), perovskite methylammonium lead iodide ($MAPbI_3$), fullerene (C_{60}) and silver (Ag), has delivered the best maximum output power (P_{max}) and open-circuit voltage (V_{OC}) of about 300 mW and 8.4 V, respectively, under AM1.5G illumination so far. A temperature/humidity meter can be directly turned on by the module outdoors in the daytime. In addition, the performances of the encapsulated module at indoor light intensity of around 1000 lux in the atmosphere are also evaluated.

Map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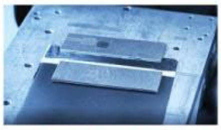
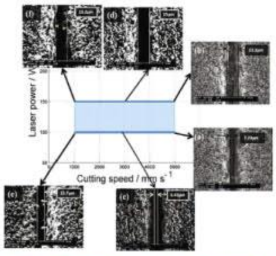


雷射振鏡切割正極鋁箔



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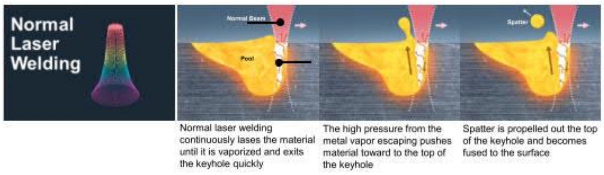
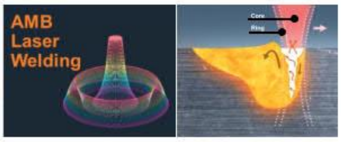


Normal laser welding continuously lases the material until it is vaporized and exits the keyhole quickly

The high pressure from the metal vapor escaping pushes material toward to the top of the keyhole

Spatter is propelled out the top of the keyhole and becomes fused to the surface



Benefits of AMB in Welding

KEYHOLE STABILIZATION

- **AMB creates a larger and more stable keyhole** allowing metal vapor to escape more easily
- The ring beam minimizes the kinetic energy of the escaping vapor **minimizing spatter**

WELD POOL STABILIZATION

- **AMB stabilizes the weld pool** and there is no further melting behind the more stable keyhole
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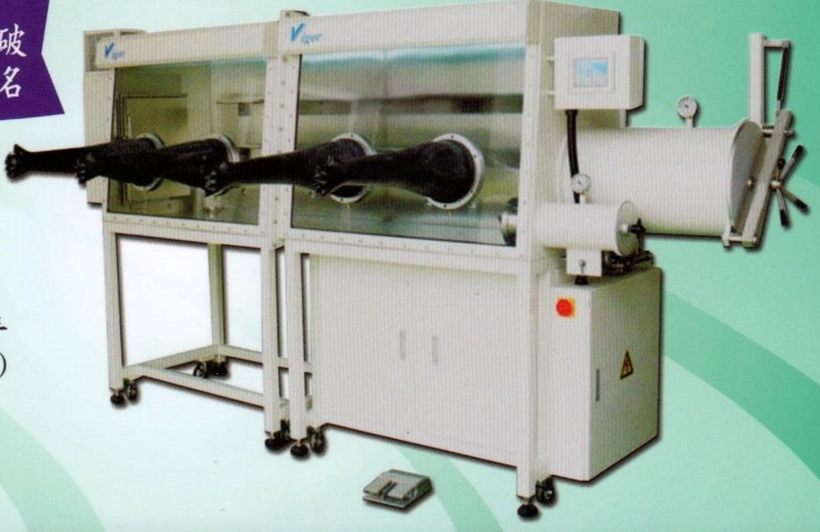

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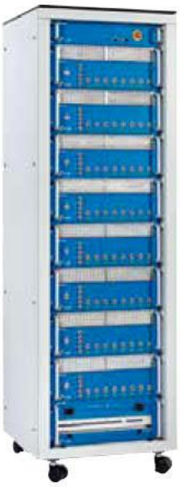

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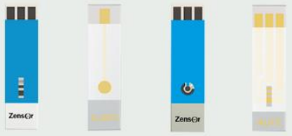

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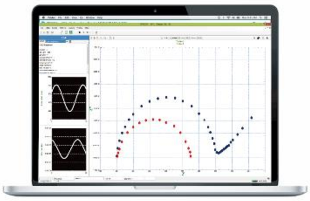
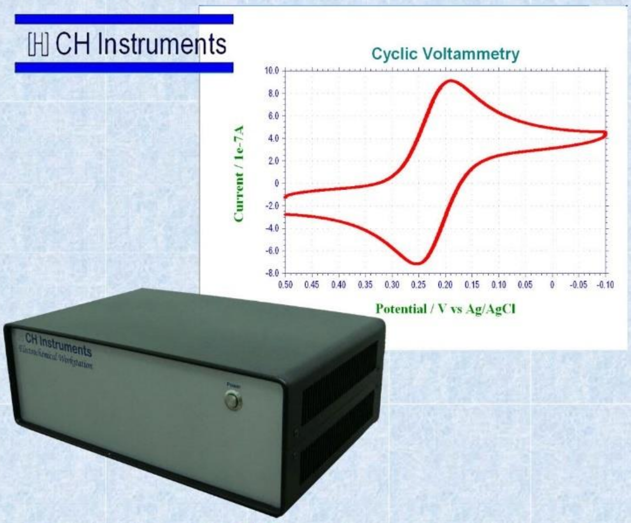


無線 交流阻抗分析儀
EIWP系列


Cyclic Voltammetry
Current / 1e-7A
Potential / V vs Ag/AgCl
10.0
8.0
6.0
4.0
2.0
0
-2.0
-4.0
-6.0
-8.0
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0
-0.05
-0.10
CH Instruments
Electrochemical Workstation


RRDE-3A
Rotating Ring Disk Electrode


ZAHNER
XPOT


Admiral
Instruments
Squidstat™ Plus
Potentiostat / Galvanostat / FRA
www.admiralinstruments.com
Channel Cable
Power Button

能源電池產業人才及技術培育基地
Talent and Technology Cultivation Base for Energy Battery Industry

明志科技大學榮獲教育部計畫補助，建置全台首座「能源電池產業人才及技術培育基地」，培育能源電池產業之專業人才

為使台灣成為未來全球經濟的關鍵力量，政府極力推動六大核心戰略產業，綠電及再生能源產業包含其中。另一方面，政府為達到「2050淨零排放」目標，設定十二項關鍵戰略，電力系統與儲能、運具電動化及無碳化等均包含在內。「建立台灣自主之鋰電池產業」，對上述之政策成敗具有關鍵之地位。因此，教育部為推動國家綠能產業的發展，培育能源電池產業專業人才及技術，結合明志科技大學綠色能源電池研究中心長期致力於鋰電池技術之研發技術，共同投入資源與人才，建置此人才及技術培育基地，整合產學研資源共同為台灣鋰電池產業競爭力奠基，期許能為產業及社會做出貢獻。

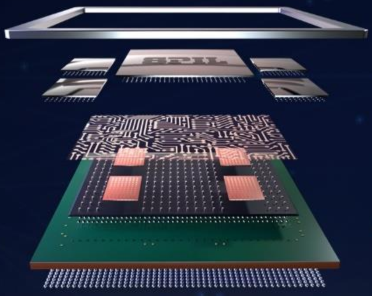
本基地將建置鈕扣及軟包型鋰電池技術人才之相關實作教室，包含材料合成、極片製備，電芯組裝、材料分析、電化學分析、安全性分析等實作教室。在材料合成場域，可以學習沉澱及鍛燒兩項電池材料常見之合成技術。極片製備場域則包含攪漿、塗佈、乾燥、輾壓、裁（膜）切等設備讓學生（員）學習。電芯組裝區域則有疊片、壓片、點焊、側封、注液、頂封、二封等設備，置於手套箱內可以製作軟包型高分子固態鋰離子電池。所屬教學設備可以接軌鋰電池之生產製程與生產作業現場環境。

本基地協同台灣電池協會、工研院、台灣科技大學、長庚大學、龍華科技大學、淡江大學、中原大學及國內鋰電池相關之企業，共同開授相關課程及合作鋰電池領域的產業實務技術。配合產學研各界之專業師資，建立完整且涵蓋理論及實作兼具之各項專業課程，提供學分學程供學生修習，並鼓勵學生參與相關的產學研發主題，提早培養學生對鋰電池產業之認識與興趣，不僅能縮短學用落差亦能培養其日後進入產業服務所需之專業能力和創新潛力。另外，此基地也提供訓練課程培訓產業學員及提供企業包班培訓服務，配合公司之需求，提供現地實習之訓練，讓學員通過考核即可就業，有效協助產業界提升員工之專業素質及企業在產業界之競爭力。

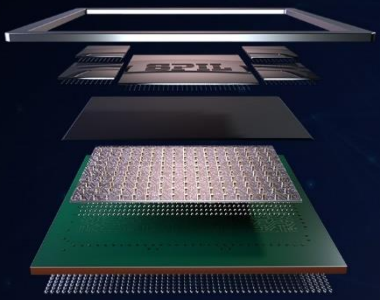
本基地也將做為產學研界之交流及工作媒合平台，舉辦校際間之跨校師生交流活動，邀請跨校師生共同參與基地之人才及技術培育工作，增進學校間的合作與基地設施之有效運用及資源整合。本基地亦會積極與國內各團體舉辦能源電池相關之研討會和論壇等交流活動，邀請學者和業界專家參與，促進領域知識的交流、共享及合作。積極與產業界共同合作發展新的技術與材料，讓基地設施之跨校資源整合不僅要能包含產業界，也必須符合產業發展之需求。

本基地預計在113年第4季建置完成，誠摯邀請各位產學研先進能夠前來指導，多多利用本基地之各項設施，能更及時也更有效的完成大家所要進行的工作。大家共同為建立台灣自主的鋰電池產業一起努力。

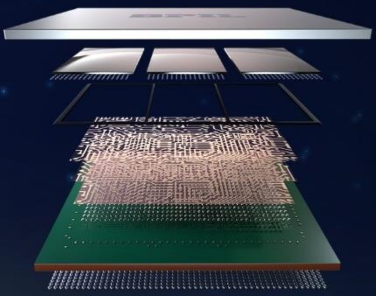
SPIL



FO-EB



2.5D IC



FO-MCM

HPC, AI, Networking

ADVANCED PACKAGING

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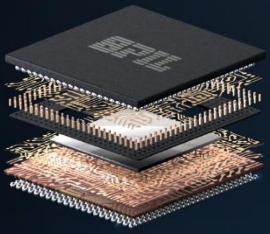
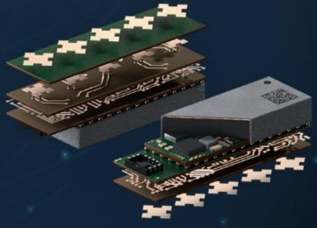
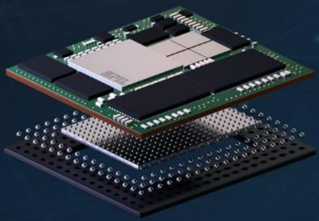
Mobile, Wearable, XR



FO-PoP



AiP



SiP

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電化學
4大主題

二氧化碳
捕捉與轉化

面對2050淨零排放，本校研發團隊針對二氧化碳之捕捉及電化學轉化已取得顯著成效，並獲得國科會專案型計畫補助，積極推動環境永續

相關研究教師：
- 化材系 顧野松 終身特聘教授
- 化學系 杜澄達 副教授
- 化材系 梁勇杰 助理教授
- 化材系 張嘉修 講座教授
- 化學系 賴英煌 副教授
- 化材系 李冠廷 助理教授

能源
儲存與轉換

研發方向為有機小分子光電材料如有機染料敏化太陽能電池、有機發光二極體發光材料...等，並進一步探討光電轉換效率。

相關研究教師：
- 化學系 張源杰 教授
- 化材系 萬傑豪 副教授

生物感測器
開發與應用

以預防醫學、精準治療為目標，本校研發團隊利用電化學技術積極研發各種生物感測器，已開發多項疾病早期檢測的方法。

相關研究教師：
- 化學系 莊旻傑 教授
- 化材系 顧野松 終身特聘教授
- 國際學院國際經營管理學位學程 施漢文 助理教授

電池開發

本校研發團隊以電化學沉積及化學合成方法和成奈米結構材料，主要集中於『超級電容器』及『鋰離子』電池的研究與開發。

相關研究教師：
- 化材系 林正裕 特聘教授
- 化材系 萬傑豪 副教授

化學工程與材料工程學系

化學系

東海大學
專利技術媒合網

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