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UNIVERSIDADE DE MACAU
UNIVERSITY OF MACAU

應用物理及材料工程研究院
INSTITUTO DE FÍSICA APLICADA E ENGENHARIA DE MATERIAIS
INSTITUTE OF APPLIED PHYSICS AND MATERIALS ENGINEERING

IAPME Newsletter

https://iapme.um.edu.mo/

ISSUE 38

11 June 2025

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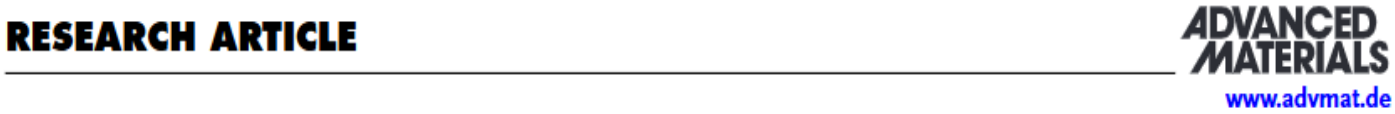
   a. Publications
   b. Research Stories
2. Teaching and Student Affairs
   a. Student Seminar Series
3. News and Events
   a. Visits
4. Upcoming Events

❖ Publications (IF≥8, and/or Nature Index; *corresponding author)

1. **Huixian Xie**, **Lingwen Liu**, **Hongyi Chen**, Kwan San Hui,* Zhuoheng Kuang, Guangmin Zhou, Yuanmiao Sun, Hui-Ming Cheng,* and **Kwun Nam Hui***. Fast-Charging Phosphorus Anodes Enabled by Fluorinated Weakly Solvated Electrolytes for Stable and High-Rate Lithium Storage. *Advanced Materials*, 202504248 (2025). DOI: 10.1002/adma.202504248. [2023 IF=27.4]



Fast-Charging Phosphorus Anodes Enabled by Fluorinated Weakly Solvated Electrolytes for Stable and High-Rate Lithium Storage

Huixian Xie, Lingwen Liu, Hongyi Chen, Kwan San Hui, Zhuoheng Kuang, Guangmin Zhou, Yuanmiao Sun, Hui-Ming Cheng,* and Kwun Nam Hui**

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❖ Research Stories

UM Research Team Develops Breakthrough Electrolyte Design to Unlock the Potential of Phosphorus-Based Anodes for Fast-Charging Lithium-ion Batteries

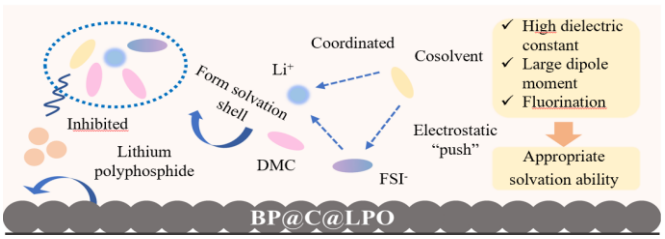
- In a major advancement for lithium-ion battery technology, we report the successful development of weakly solvated electrolytes (WSEs) specifically tailored for phosphorus-based anodes—a promising but previously limited anode material due to severe irreversible capacity loss.

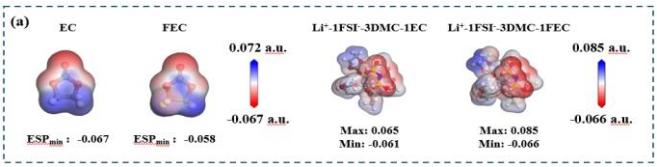
- This breakthrough addresses two longstanding challenges: sluggish reaction kinetics and the dissolution of lithium polyphosphide intermediates. By engineering electrolytes with high dielectric constants, strong dipole moments, and fluorinated co-solvents, and by finely optimizing the solvation structure, our study effectively suppresses polyphosphide dissolution, stabilizes the electrode–electrolyte interface, and dramatically enhances electrochemical kinetics.

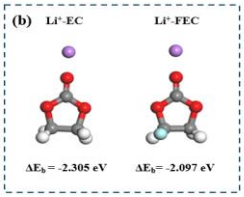
- These advances not only overcome fundamental limitations of phosphorus anodes but also pave the way for their practical integration into high-power lithium-ion batteries, opening new pathways for next-generation energy storage.

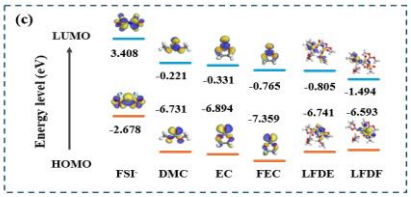
- The phosphorus-based anode achieved a high capacity of 2615.2 mAh g^{-1} at 1C, with 91.7% retention after 1000 cycles. Remarkably, it maintained 96.7% retention over 1500 cycles at 4C and 97% retention after 300 cycles at 0°C, demonstrating excellent stability under high-rate and low-temperature conditions.

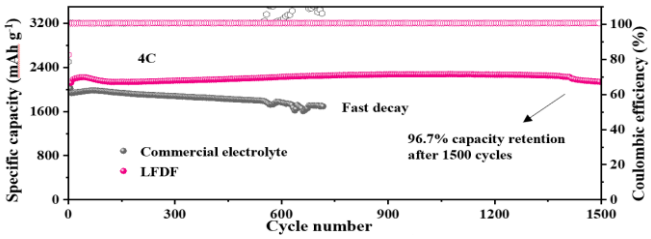
(from left) Huixian Xie (謝惠嫻),
Lingwen Liu (劉凌雯),
Hongyi Chen (陳鴻毅),
Prof. Kwun Nam Hui (許冠南)









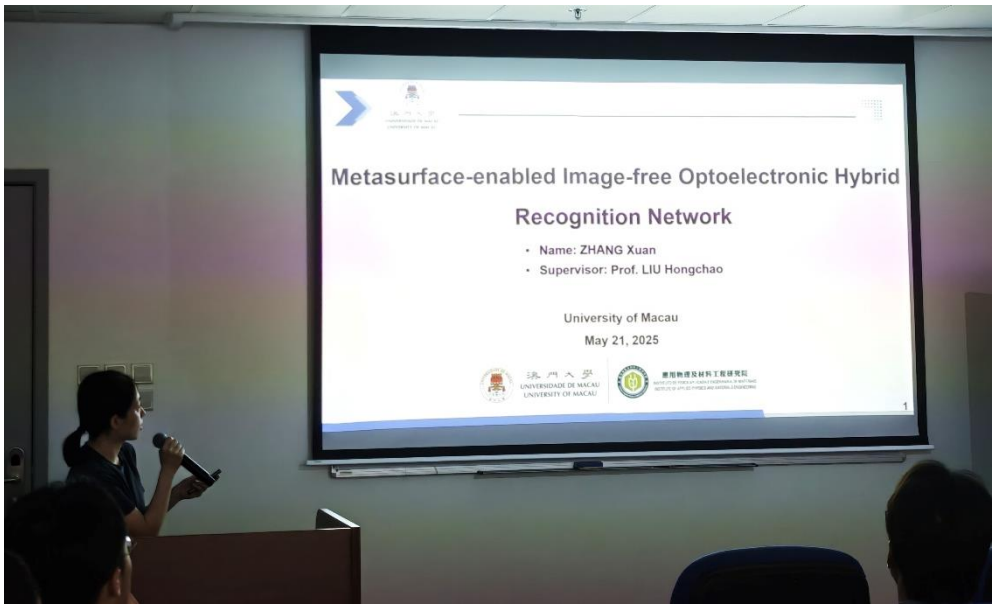


Huixian Xie, **Lingwen Liu**, **Hongyi Chen**, Kwan San Hui,* Zhuoheng Kuang, Guangmin Zhou, Yuanmiao Sun, Hui-Ming Cheng,* and **Kwun Nam Hui***. Fast-Charging Phosphorus Anodes Enabled by Fluorinated Weakly Solvated Electrolytes for Stable and High-Rate Lithium Storage. *Advanced Materials*, 202504248 (2025). DOI: 10.1002/adma.202504248. [2023 IF=27.4]

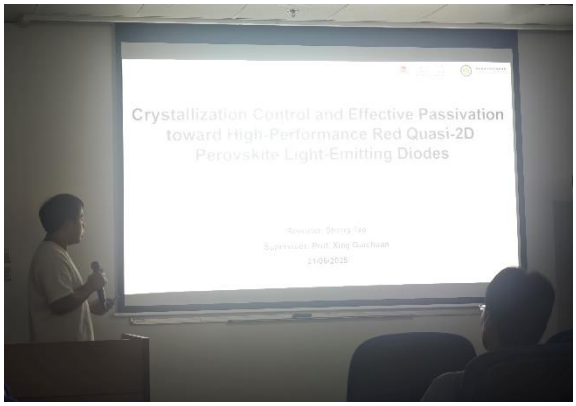
Prof. Kwun Nam Hui is the corresponding author of this study. The first authors are Huixian Xie, Lingwen Liu, Hongyi Chen. This work was supported by the Science and Technology Development Fund, Macau SAR (File no. 0033/2023/ITP1, 0022/2023/RIB1, 046/2019/AFJ, 0070/2023/AFJ), University of Macau (File no. MYRG2022-00223-IAPME and MYRG-GRG2024-00166-IAPME).

❖ IAPME Student Seminar Series 2025 (3rd Round)

The Institute of Applied Physics and Materials Engineering held **the IAPME Student Seminar Series 2025 – 3rd Round** on May 21, 2025, bringing together more than 20 PhD students and academic staff members. The seminar provided a dynamic platform for students to present their latest research and receive valuable feedback from peers and faculty members.



Five PhD students showcased their work across a broad range of cutting-edge topics. Kicking off the session, Zhichao Yu (余智超) presented on the decisive role of axial coordination on electrocatalytic NOx reduction in Co single atom catalysts. Following that, Xuan Zhang (張玄) explored the integration of machine learning algorithms and metasurfaces in computational imaging. Next, Tao Sheng (盛濤) shared progress on crystallization control and effective passivation for high-performance red perovskite LEDs. Continuing the session, Yuyang Zhao (趙玉陽) investigated the Ca/Si-dependent size of silica nanoparticles derived from C-S-H at high water-to-solid ratios. Finally, Zirui Zhao (趙梓睿) presented a deep learning-driven evaluation and prediction of ion-doped NASICON materials to enhance solid-state battery performance. The seminar reflects IAPME's ongoing commitment to interdisciplinary research and student development in areas spanning energy, optics, electronics, and functional materials.



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❖ Delegation from Harbin Institute of Technology (Shenzhen) Visited IAPME

On May 23, 2025, a delegation consisting of 37 undergraduate, master's, and PhD students from the School of Frontier Sciences, Harbin Institute of Technology (Shenzhen), led by Dean Qian Zhang (張倩), visited the Institute of Applied Physics and Materials Engineering (IAPME) of the University of Macau (UM). The group received a warm welcome from the IAPME professors.

A discussion session, chaired by Prof. Guoxing Sun, was held in the afternoon. 2 Associate Directors, Prof. Handong Sun and Prof. Hui Pan, introduced IAPME's research directions and admission details respectively. Several Professors, including Prof. Songnan Qu, Prof. Bingpu Zhou, Prof. Haifeng Li, and Prof. Qing Li presented the main research areas of their groups. Dean Qian Zhang enthusiastically introduced HIT (Shenzhen)'s talent recruitment programs and benefits, warmly inviting UM's PhD students to apply. The visiting students actively engaged with the speakers, asking insightful questions about research careers and academic lives. After the session, the delegation had an IAPME lab tour. The visit concluded with a group photo to commemorate the fruitful exchanges.

❖ Upcoming Events

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IAPME Seminar

Nanoplatforms Overcoming Physiological Barriers for Tissue Regeneration and Precision Imaging

12 June 2025
Prof. Wei TANG
Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences
Venue: N23-4018
Time: 10:30 - 11:30
Hosted by: Prof. Guichuan XING

Abstract

Recent advances in nanomedicine have opened new avenues for targeted drug delivery and controlled release, yet the dense extracellular matrices and physiological barriers in tissues such as bone, cartilage, and brain severely hinder the penetration and efficacy of both therapeutic molecules and nanomaterials. Overcoming these physiological barriers to achieve rapid penetration and therapeutic efficacy remains a critical challenge. To address these issues, we have developed a series of strategies and nanoplatforms capable of traversing tissue barriers for tissue regeneration and precision imaging, including: (1) Hydrogen-releasing biomaterials that modulate deep tissue microenvironments through in situ H2 penetration; (2) Specifically assembled nanomaterials enabling long-term retention in pathological microenvironments; and (3) Ultrasmall nanoprobes for precise visualization of deep-seated bacterial infections. This presentation will highlight our recent progress in: Pathological microenvironment-responsive H2-releasing nanomaterials for remodeling senescent and chronic inflammatory microenvironments, with applications in aged bone repair, arthritis therapy, and stroke treatment; Self-assembled cartilage-targeting lubricating layers to prevent arthritis progression; Glycosylated polydopamine-based ultrasmall aggregation-induced emission nanoparticles for precision bacterial imaging in complex biological environments.

Biography

Prof. Wei TANG, Professor at the Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences (SIAT, CAS), obtained her B.S. (2009) and Ph.D. (2016) in Materials Science and Engineering from the East China University of Science and Technology under the supervision of Academician Changsheng LIU, subsequently joining SIAT where she currently conducts research at the Research Center for Neural Engineering, focusing on hydrogen-releasing biomaterials for aging-related tissue repair (bone, cartilage, neural), publishing 17 first/corresponding-author papers (e.g., Nat Commun, Sci Adv) and leading 3 NSFC projects, with recognitions including the Young Top-notch Talents of Guangdong, CAS Youth Innovation Promotion Association, and global top 2% scientist status.

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