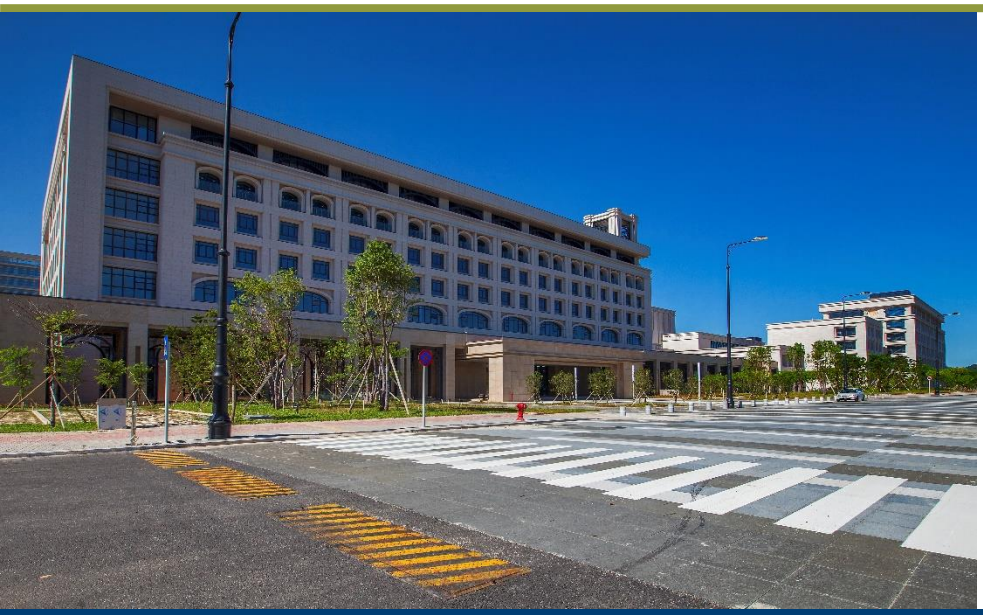
澳門大學
UNIVERSIDADE DE MACAU
UNIVERSITY OF MACAU

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 53

24 September 2025

✧ Content

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

1. **Yijie Wei**, Zhengjie Chen, **Xin Guo***, Huixian Xie, Zhefei Sun, Sahar Osman, Jun Xiao, Tianyu Chen, Kwan San Hui, Hui-Ming Cheng, **Kwun Nam Hui***. MOF Glass Confined Black Phosphorus via Co—P Anchoring for Advanced Lithium-Ion Battery Anodes. *Advanced Science,* e11772 (2025). DOI: 10.1002/advs.202511772. [2024 IF=14.1]

RESEARCH ARTICLE

ADVANCED SCIENCE Open Access

www.advancedscience.com

MOF Glass Confined Black Phosphorus via Co—P Anchoring for Advanced Lithium-Ion Battery Anodes

Yijie Wei, Zhengjie Chen, Xin Guo, Huixian Xie, Zhefei Sun, Sahar Osman, Jun Xiao, Tianyu Chen, Kwan San Hui, Hui-Ming Cheng, and Kwun Nam Hui**

澳門大學
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

ISSUE 53 24 September 2025

❖ Research Stories

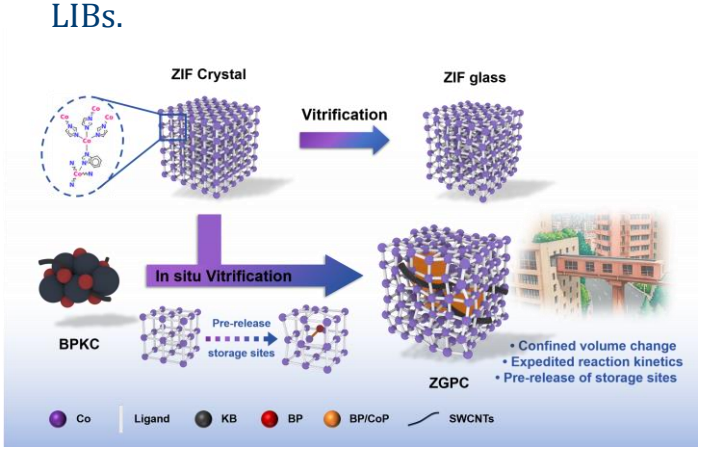
UM research team successfully developed advanced lithium-ion battery anodes based on MOF glass confined black phosphorus via Co–P anchoring

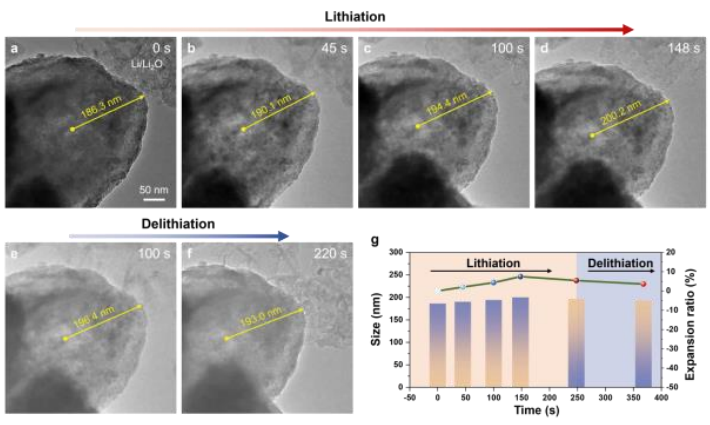
- A composite anode material is fabricated via in situ vitrification, in which BP nanoparticles and a Ketjenblack/single-walled carbon nanotube conductive network are embedded into a ZIF-derived glass matrix. In this composite structure, BP is encapsulated within the ZIF glass matrix and strongly anchored to its cobalt sites via Co–P bonding to form a stable BP/CoP heterostructure, while the carbon network interweaves through the glass to establish continuous electron and ion transport pathways.

Mr. Yijie Wei
(魏一杰)

Prof. Kwun Nam Hui
(許冠南)

- This configuration not only facilitates rapid electrochemical kinetics and pre-activates deeply embedded storage sites, but also significantly buffers the volume changes of BP. As a result, the composite exhibits an ultralow volume variation (3.5% after delithiation) and delivers substantially enhanced capacity and long-term cycling stability (652.3 mAh g^{-1} with ~98% capacity retention over 1000 cycles at 1 A g^{-1}), offering a new strategy for engineering high-performance alloy/MOF glass hybrid anode materials for next-generation LIBs.





Yijie Wei, Zhengjie Chen, **Xin Guo***, Huixian Xie, Zhefei Sun, Sahar Osman, Jun Xiao, Tianyu Chen, Kwan San Hui, Hui-Ming Cheng, **Kwun Nam Hui***. MOF Glass Confined Black Phosphorus via Co—P Anchoring for Advanced Lithium-Ion Battery Anodes. *Advanced Science,* e11772 (2025). DOI: 10.1002/advs.202511772. [2024 IF=14.1]

Prof. Kwun Nam Hui is the corresponding author of this study. The first author is Yijie Wei, a Ph.D. student in the IAPME. This work was supported by the Science and Technology Development Fund (FDCT) of Macao S.A.R. (0033/2023/ITP1, 0022/2023/RIB1, 046/2019/AFJ, 0007/2021/AGJ, 0070/2023/AFJ), the Multi-Year Research Grants (MYRG2022-00223-IAPME and MYRG-GRG2024-00166-IAPME) from the Research Services and Knowledge Transfer Office at the University of Macau, the High-Performance Computing Cluster (HPCC) of the Information and Communication Technology Office (ICTO) at the University of Macau.

❖ Seminars

On September 12, 2025, our institute welcomed Prof. Jia Zhu (朱嘉) from Nanjing University for a seminar titled "*Manipulating the Flow of Light & Heat at Nanoscale*". Prof. Zhu, a leading researcher in nanophotonics and thermal science, is a fellow of the Materials Research Society (MRS), Optica, and the Royal Society of Chemistry (RSC). The seminar drew an engaged audience of over 20 institute members and students.

Prof. Zhu began by surveying his group's progress in photothermal control, drawing inspiration from Wiener optics and advanced nanophotonic strategies. He highlighted the development of scalable, hierarchically designed selective thermal emitters and coating films engineered to align their emissivity with the Earth's atmospheric transparency window. These materials enable passive radiative cooling, allowing heat to be rejected to outer space without energy input—offering promising solutions for urban heat mitigation and thermal management in devices and buildings.

In the second part of his talk, Prof. Zhu presented breakthroughs in interfacial solar evaporation, utilizing broadband plasmonic absorbers and transpiration-inspired water pathways to achieve solar-to-vapor conversion efficiencies exceeding 90%. He discussed real-world applications ranging from desalination and zero-liquid discharge (ZLD) to sterilization and lithium extraction, emphasizing the translational potential of nanoscale light–heat control technologies.

The seminar concluded with a lively Q&A session, where attendees exchanged ideas with Prof. Zhu on materials design, scalable manufacturing, and collaboration opportunities. The visit further strengthened ties between the two institutions, reinforcing shared goals in sustainable photonics and thermal technologies.

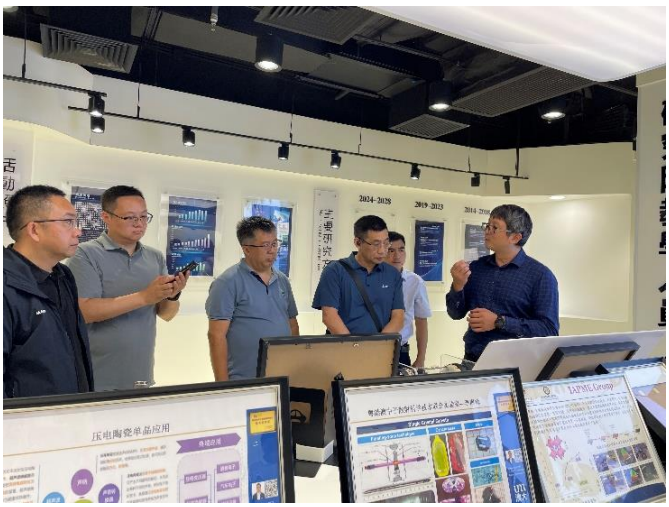
❖ Visits

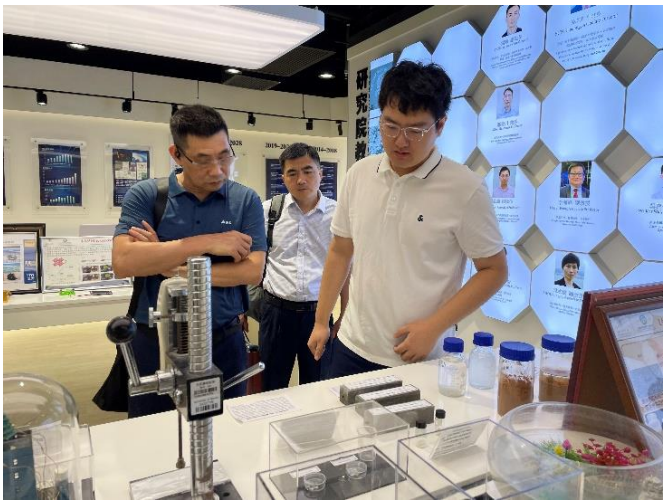
On September 17, 2025, a delegation from Jiangsu Hongyi Security Technology Co., Ltd. (江蘇紅翼安防科技有限公司, hereinafter referred to as Hongyi Technology) visited our institute to explore potential avenues for collaboration in advanced energy and materials research.

The visit began with Prof. Songnan Qu presenting an overview of the institute's development, research priorities, and strategic initiatives. This was followed by a showcase of recent achievements led by Prof. Shuangpeng Wang and Prof. Qu.

Enterprise representatives, including Mr. Jiapeng Liu (劉佳鵬), Chairman of Hongyi Technology, and Mr. Yanjie Liu (劉彥杰), Chairman of Han Hydrogen Power (Zhuhai) Technology Co., Ltd. (瀚氫動力(珠海)科技有限公司), praised the institute's research accomplishments. They expressed strong interest in establishing future cooperation, particularly in promoting the transformation of research outcomes in fields such as hydrogen energy and the low-altitude economy within the Guangdong–Macao In-Depth Cooperation Zone in Hengqin.

The visit marked a meaningful step toward strengthening industry–academia ties and accelerating innovation in sustainable technologies.





❖ Upcoming Events

澳門大學
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 Seminar

Silicon-Enriched Biomass-Derived Hard Carbon for High-Capacity Lithium-ion Battery Anodes

26 September 2025
Prof. Yimin CHAO
Foshan Xianhu Laboratory
Venue: N23-4018
Time: 16:30 - 17:30
Hosted by: Prof. Kwun Nam HUI

Abstract

Silica-enriched hard carbon derived from barley husks (BHs) is investigated as a high-performance anode material for lithium-ion batteries (LIBs). By systematically incorporating silica into the carbon matrix at different ratios, the resulting composite anodes exhibit a significant enhancement in specific capacity, achieving up to at C/5, far exceeding commercial graphite. The synergistic interaction between silica and carbon effectively mitigates the volume expansion of SiO_2, ensuring improved cycling stability and rate performance. A full cell was assembled using NMC622 as the cathode, delivering an energy density of at C/10 and maintaining 89% capacity retention after 100 cycles, surpassing conventional graphite-based cells. The anode fabrication follows a straightforward, scalable approach, relying on simple carbonization and mechanical mixing without requiring complex synthesis steps, making it suitable for large-scale production. Comparative electrochemical analysis reveals that the prepared anodes outperform graphite in terms of both specific capacity and rate capability, making them a viable, sustainable alternative for next-generation LIB anodes.

Biography

Prof. Yimin CHAO is currently a Distinguished Expert at Xianhu Laboratory, where he focuses on the electrochemical properties of nanomaterials and their industrial applications. His work emphasizes creating a collaborative ecosystem that integrates production, academia, research, and application. He has extensive expertise in analyzing electrochemical phenomena, establishing structure–property relationships, and elucidating underlying mechanisms. In particular, he has made original contributions to the lithium-ion storage kinetics of nanosilicon and the development of high-capacity electrode materials. Previously, Prof. Chao was the Head of the Nanomaterials Innovation Laboratory in the School of Chemistry at the University of East Anglia (UEA). He is a Fellow of the Royal Society of Chemistry (RSC) and serves as Chair of the RSC Chemical Nanoscience and Nanotechnology Group. He is also a panel member for the UKRI Future Leaders Fellowships sift and interview panels. Prof. Chao has accumulated a broad range of experience in the synthesis of nanoscale materials, their environmental and biological impacts, and their sustainable applications. His current research themes include the functionalization and characterization of silicon quantum dots (Si-QDs) and their applications in lithium-ion batteries and thermoelectric modules. His research has been funded by multiple national and international organizations.

Enquiry: iampe.enquiry@um.edu.mo

Contact Us

Email
iapme.enquiry@um.edu.mo