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

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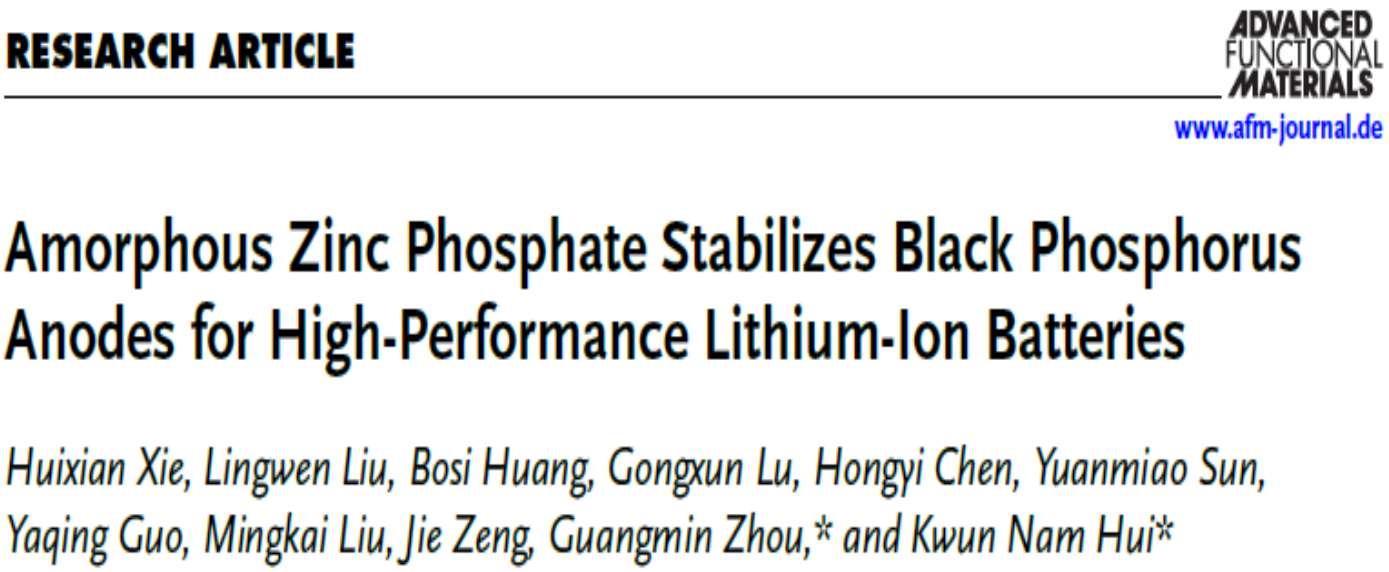
ISSUE 49

27 August 2025

✧ Content

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

1. **Huixian Xie**, Lingwen Liu, Bosi Huang, Gongxun Lu, Hongyi Chen, Yuanmiao Sun, Yaqing Guo, Mingkai Liu, Jie Zeng, Guangmin Zhou*, and **Kwun Nam Hui***. Amorphous Zinc Phosphate Stabilizes Black Phosphorus Anodes for High-Performance Lithium-Ion Batteries. *Advanced Functional Materials*, e13540 (2025). DOI: 10.1002/adfm.202513540. [2025 IF=19.0]



RESEARCH ARTICLE

ADVANCED FUNCTIONAL MATERIALS
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Amorphous Zinc Phosphate Stabilizes Black Phosphorus Anodes for High-Performance Lithium-Ion Batteries

Huixian Xie, Lingwen Liu, Bosi Huang, Gongxun Lu, Hongyi Chen, Yuanmiao Sun, Yaqing Guo, Mingkai Liu, Jie Zeng, Guangmin Zhou, and Kwun Nam Hui**

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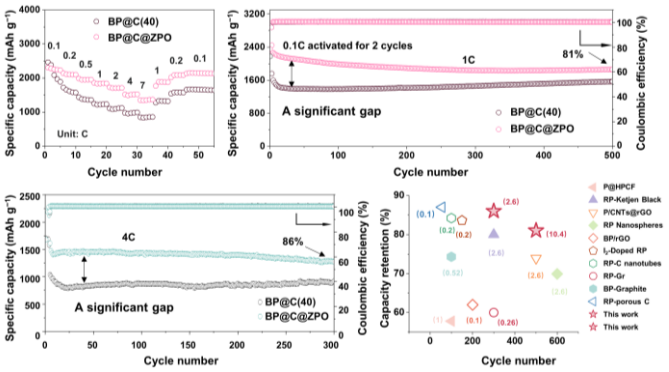
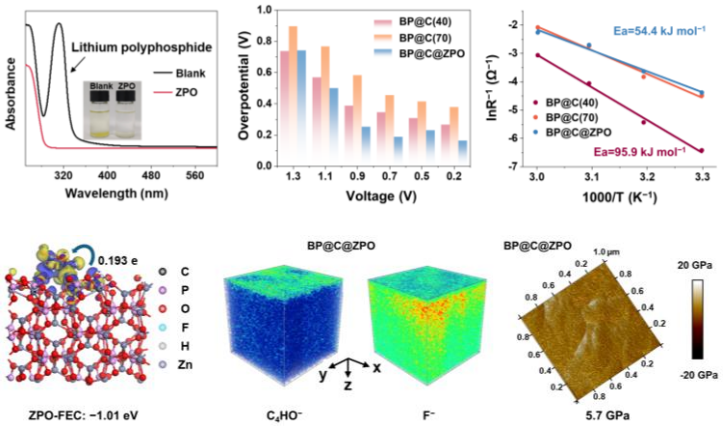
❖ Research Stories

UM Research Team Develops Amorphous Zinc Phosphate to Stabilize Black Phosphorus Anodes for High-Performance Lithium-Ion Batteries

- This work is dedicated to addressing the critical challenges hindering the practical application of black phosphorus (BP) as an anode material for lithium-ion batteries (LIBs). BP is promising due to its high theoretical capacity and favorable lithiation potential. However, its low electrical conductivity, significant volumetric expansion during cycling, and dissolution of lithium polyphosphides (LiPPs) lead to rapid capacity degradation.
- To address these problems, the research team proposes amorphous zinc phosphate (ZPO) as a multifunctional modifier. Its isotropic structure suppresses volumetric changes, while abundant structural defects boost electrical conductivity. DFT and experiments confirm strong LiPPs adsorption, mitigating the shuttle effect. Moreover, it accelerates FEC decomposition to form a stable, fluoride-rich SEI.

Ms. Huixian Xie (謝惠嫻) | Ms. Lingwen Liu (劉凌雯) | Prof. Kwun Nam Hui (許冠南)





- The ZPO-modified BP anode demonstrates exceptional electrochemical performance, retaining 86% capacity after 300 cycles at 4C. It significantly outperforms conventional carbon-based modifications, achieving balanced optimization of structural stability, interfacial durability, and redox kinetics. These findings enhance the commercial viability of BP for next-generation energy storage systems.

Huixian Xie, Lingwen Liu, Bosi Huang, Gongxun Lu, Hongyi Chen, Yuanmiao Sun, Yaqing Guo, Mingkai Liu, Jie Zeng, Guangmin Zhou*, and **Kwun Nam Hui***. Amorphous Zinc Phosphate Stabilizes Black Phosphorus Anodes for High-Performance Lithium-Ion Batteries. *Advanced Functional Materials*, e13540 (2025). DOI: 10.1002/adfm.202513540. [2025 IF=19.0]

Prof. Kwun Nam Hui is the corresponding author of this study. This work was supported by the Science and Technology Development Fund, Macau SAR (File no. 0033/2023/ITP1, 0022/2023/RIB1, 046/2019/AFJ, 0007/2021/AGJ, 0007/2023/AFJ), University of Macau (File no. MYRG2022-00223-IAPME and MYRG-GRG2024-00166-IAPME), Guangdong Basic and Applied Basic Research Foundation (File no. 2022A1515110994, 2024A1515030228, and 2022A0505030028).

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❖ Orientation for New Students

On 14 August 2025, we held an orientation for new students to welcome the master's and Ph.D. students of the 2025/2026 cohort. Prof. Handong Sun, Associate Director of IAPME, kicked off the event by introducing the current status of UM and IAPME. He advised students to pay close attention to the details of their research work, as these would distinguish them from their peers and pave the way for a successful research career. Additionally, he encouraged students to explore innovative ideas, assuring them that their supervisors would support them in achieving breakthroughs in their work.

Prof. Handong Sun
(孫漢東)

On this occasion, the IAPME Academic Awards for 2024/2025 were also presented. Prof. Bingpu Zhou (周冰朴) received the *Excellence in Service* award; Prof. Yongqing Cai (蔡永青) received the *Excellence in Teaching* award; and Prof. Songnan Qu (曲松楠) received the *Excellence in Research* award. A round of applause was given to the awardees, and it is hoped that the institute will continue to excel in various aspects throughout the new academic year.

Prof. Bingpu Zhou
Excellence in Service

Prof. Yongqing Cai
Excellence in Teaching

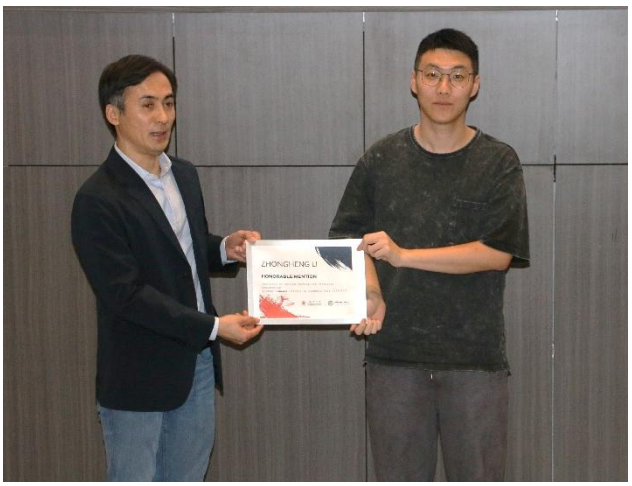
Prof. Songnan Qu
Excellence in Research

In addition, the IAPME Ph.D. Student Seminar Contest Awards for 2024/2025 were also presented. Yulin Mao (毛玉麟) won the Champion title, Tao Sheng (盛濤) was awarded 1st Runner-Up, Ting Ding (丁汀) received 2nd Runner-Up, and Xue Li (李雪), Zhongheng Li (李中恆), and Chufa Liu (劉春發) received Honorable Mentions. A round of applause was also given to the awardees, and it is hoped that the Ph.D. students will continue to achieve more in their research endeavors.

Tao Sheng
1st Runner-Up

Ting Ding
2nd Runner-Up

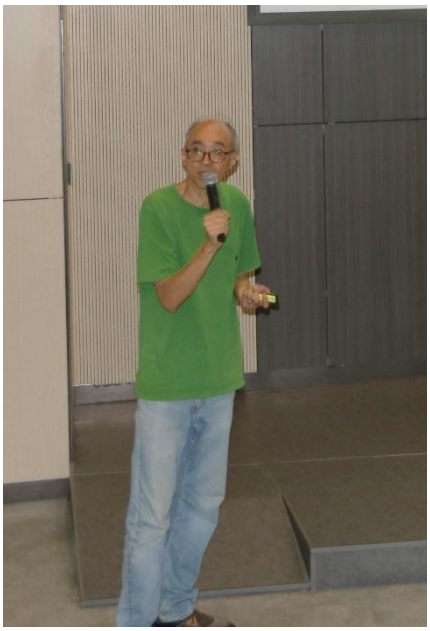
Xue Li
Honorable Mention



Zhongheng Li
Honorable Mention

The second session of the orientation focused on highlighting key academic information, administrative procedures, laboratory operations, and safety protocols for the students. Lastly, Ms. Yifan Liu (劉逸凡), a second-year Ph.D. student, shared some useful tips with her juniors to help them adapt more easily to the new environment.

The institute is committed to providing the utmost support to its students and looks forward to witnessing their success in the foreseeable future.



Dr. Mike Chio

Prof. Hui Pan

Ms. Yifan Liu

❖ Ph.D. Student Thesis Oral Defenses

Yike Huang of Prof. Huaiyu Shao's group presented "Metal organic framework-based hybrid electrolytes for Mg-ion conductor" in his oral defense on August 19, 2025.

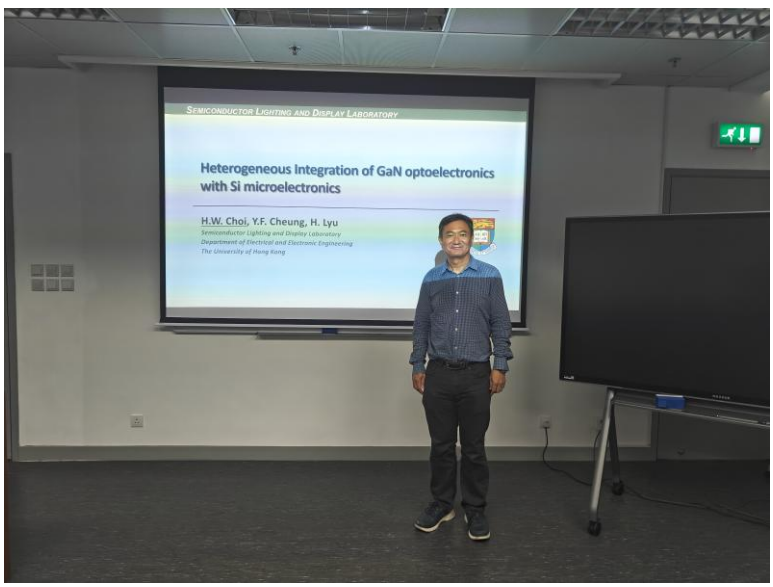
Congratulations to Dr. Yike Huang!

(from left) Prof. Kwun Nam Hui (許冠南), Prof. Huaiyu Shao (邵懷宇), Dr. Yike Huang (黃一可), Prof. Hui Pan (潘暉), Prof. Shi Chen (陳石) and Prof. Yigang Yan (嚴義剛, SCU)

❖ Seminars

Prof. Anthony H. W. Choi ((蔡凱威) from the Department of Electrical and Electronic Engineering at The University of Hong Kong visited IAPME on 7–8 August 2025. During his visit, he delivered an insightful presentation titled "*Heterogeneous Integration of GaN Optoelectronics with Si Microelectronics*" The seminar was hosted by Prof. Handong Sun.

Prof. Choi is a Full Professor and Associate Head of the Department of Electrical and Electronic Engineering at The University of Hong Kong. He received his Ph.D. from the National University of Singapore under the supervision of Prof. Soo Jin Chua and completed his postdoctoral training in Prof. Martin Dawson's team at the University of Strathclyde, Glasgow, where he contributed to pioneering development work on III-nitride emissive micro-light-emitting diode arrays, demonstrating applications in micro-displays and high-efficiency light sources. His current research interests include microdisk lasers, chip-scale color micro-LED displays, and GaN–Si heterogeneous integration.



In his talk, Prof. Choi first provided an overview of GaN-based photonic integration. To operate GaN optoelectronic devices, systems often incorporate Si microelectronics in the form of integrated circuits (ICs), such as drivers, amplifiers, and various other types of ICs. Traditionally, GaN optoelectronic devices and Si microelectronics are individually packaged and then soldered onto printed circuit boards (PCBs) to form functional circuits. Although widely adopted, this type of integration tends to make circuits and systems bulkier than necessary.

Prof. Choi also presented the concept of heterogeneous integration of GaN optoelectronic devices (such as LEDs and photodiodes) with Si-based electronics at the chip-scale level. This includes the integration of GaN LEDs and LED arrays with CMOS driving circuits, and GaN photodetectors with CMOS transimpedance amplifiers.

During his visit to IAPME, Prof. Choi exchanged ideas with members of Prof. Sun's group.

On 11 August 2025, Prof. Haizheng Zhong (鐘海政) from the School of Materials Science and Engineering, Beijing Institute of Technology, visited IAPME and delivered a seminal lecture titled *"The Device Analysis of QLED toward Industrialization"* The talk highlighted cutting-edge research on quantum dot light-emitting diodes (QLEDs), drawing significant interest from institute members and students. The visit was hosted by Prof. Shuangpeng Wang.

Prof. Zhong is a leading scholar in the field of colloidal quantum dots for photonics and optoelectronics. His current research interests focus on colloidal quantum dots for applications in photonics and optoelectronics. His recent honors include the National Science Foundation for Excellent Young Scholars (2017), the Beijing Science and Technology Award (2018), and the IDW Best Paper Award (2019). Since 2019, he has served as a Senior Editor for the *Journal of Physical Chemistry Letters*, and became Executive Editor in 2020.

During the seminar, Prof. Zhong briefly reviewed the 30-year development history and achievements of QLED technology, highlighting the main challenges hindering its transition from laboratory research to industrialization. He emphasized that consistency issues caused by positive aging during operation and storage are particularly prominent. Prof. Zhong systematically summarized the global research progress in QLED device analysis and introduced his team's achievements and insights into novel analysis methods, such as transient electroluminescence, electrochemical impedance, and machine learning.

Prof. Zhong's talk underscored the pivotal role of fundamental research in addressing industrial challenges. His analytical frameworks offer a roadmap for overcoming the final barriers to QLED commercialization. The lecture concluded with an interactive Q&A session, fostering discussions on next-generation optoelectronic materials.

During the visit, Prof. Zhong joined an IAPME lab tour, engaged in in-depth discussions with several professors and PhD students, and expressed a willingness to deepen cooperation.