



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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- a. Publications
- b. Research Stories

2. Community News

3. News and Events

- a. Seminars
- b. Visits



❖ Publications (IF \geq 10; *corresponding author)

1. **Yitao Jiao**, Jian Dai, Zhenhao Fan, Junye Cheng, Guangping Zheng, Lawan Grema, Junwen Zhong, **Hai-Feng Li***, Dawei Wang*, “Overview of high-entropy oxide ceramics.” *Materials Today* 77, 92 (2024). DOI: 10.1016/j.mattod.2024.06.005 [2023 IF=21.1]
2. **Yupeng Liu**, **Bingzhe Wang**, Yunsen Zhang, Jia Guo, Xiaoyi Wu, Defang Ouyang, Shi Chen, Yeqing Chen, Shuangpeng Wang, Guichuan Xing, **Zikang Tang***, **Songnan Qu***, “Perylenedioic Acid-Derived Carbon Dots with Near 100% Quantum Yield in Aqueous Solution for Lasing and Lighting”. *Advanced Functional Materials*. 2024, 2401353. DOI: 10.1002/adfm.202401353. [2023 IF=18.5]
3. **Huifang Xu**, **Qingbin Jiang**, Kwan San Hui*, Shuo Wang, Lingwen Liu, Tianyu Chen, Yunshan Zheng, Weng Fai Ip, Duc Anh Dinh, Chenyang Zha, Zhan Lin, **Kwun Nam Hui***, “Interfacial "Double-Terminal Binding Sites" Catalysts Synergistically Boosting the Electrocatalytic Li₂S Redox for Durable Lithium-Sulfur Batteries.” *ACS Nano* 2024, 18, 8839-8852. DoI: 10.1021/acsnano.3c11903. [2023 IF=15.8]



4. **Sen Ding**, Dazhe Zhao, Yongyao Chen, Ziyi Dai, Qian Zhao, Yibo Gao, Junwen Zhong, Jianyi Luo, and **Bingpu Zhou***, “Single channel based interference-free and self-powered human-machine interactive interface using eigenfrequency-dominant mechanism”, *Advanced Science* 2024, 2302782. DOI:10.1002/advs.202302782 [2023 IF=14.3]
5. **Xiaoke Wang**, Titi Li, Xixi Zhang, Yaxin Wang, Hongfei Li, **Hai-Feng Li***, Gang Zhao*, Cuiping Han*, “High-performance magnesium/sodium hybrid ion battery based on sodium vanadate oxide for reversible storage of Na⁺ and Mg²⁺.” *Journal of Energy Chemistry* 96, 79 (2024). DOI: 10.1016/j.jechem.2024.04.016 [2023 IF=14.0]

❖ Research Stories

UM research team successfully develops carbon dots with near 100% quantum yield in aqueous solution for lasing and lighting

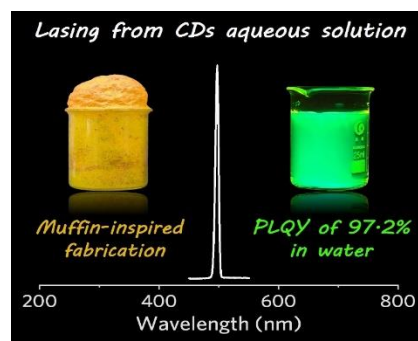
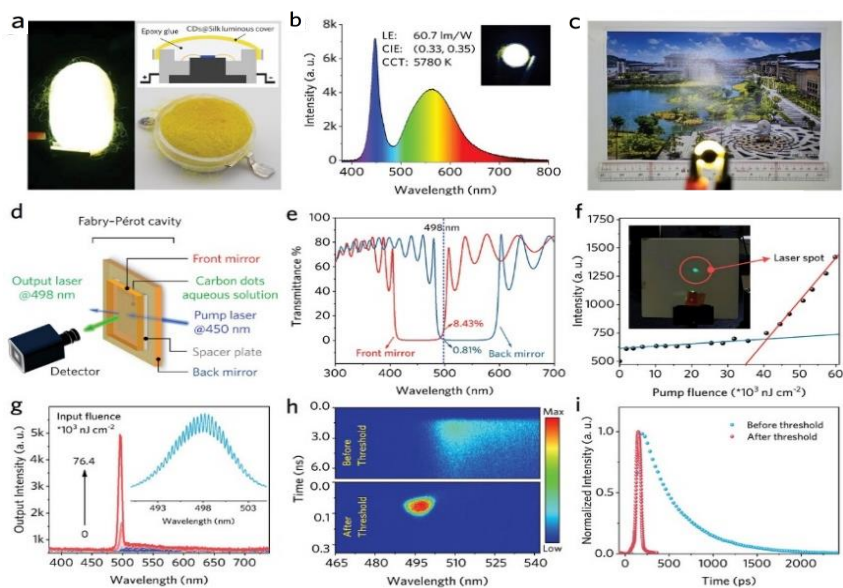
- Highly luminescent CDs with unprecedented photoluminescence quantum yield (PLQY) over 97.2% in water.
- The first optically pumped green lasing emission in the CDs aqueous solution.
- Moreover, a biomaterial-based white light emitting diode is fabricated using the CDs-stained silks as a fluorescence conversion cover to realize a high luminous efficiency of 60.7 lm W⁻¹ with CIE color coordinate of (0.33, 0.35).



(from left) Dr. Yupeng LIU and Dr. Bingzhe WANG



(from left) Prof. Zikang TANG and Prof. Songnan QU



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Prof. Songnan QU and Prof. Zikang TANG are the corresponding authors of this study. The first authors are Mr. Yupeng LIU, a Ph.D. student in IAPME, and Dr. Bingzhe WANG. This work was financially supported by the Science and Technology Development Fund of Macau SAR (0128/2020/A3, 0131/2020/A3, 0007/2021/AKP, 006/2022/ALC and 0139/2022/A3), the Research and Development Grant for Chair Professor Fund from the University of Macau (CPG2020-00026-IAPME), the Shenzhen-Hong Kong-Macao Science and Technology Innovation Project (Category C) (SGDX20210823103803021, EF029/IAPME-QSN/2022/SZSTIC), the National Natural Science Foundation of China (62205384), and the Wuyi University-Macau University Joint Research Fund (2019WGALH08).

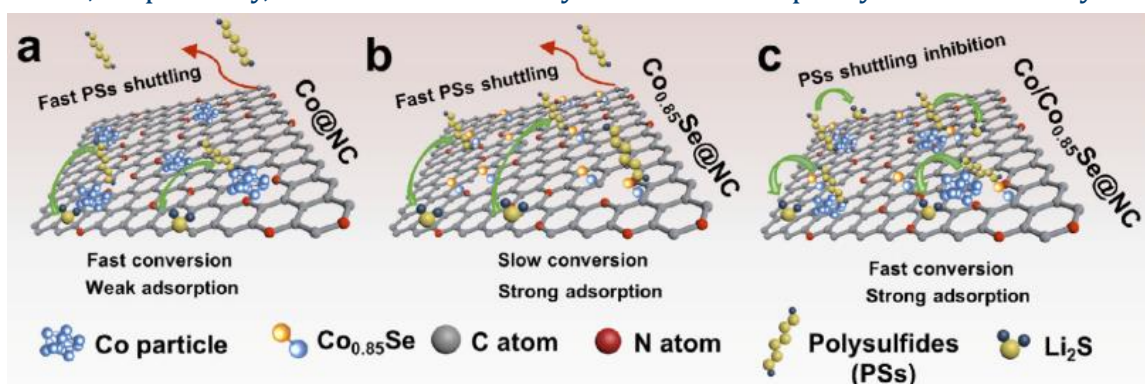
❖ Research Stories

UM research team successfully developed Interfacial “Double-Terminal Binding Sites” Catalysts Synergistically Boosting the Electrocatalytic Li₂S Redox

- The MOF-derived regular dodecahedral mesoporous conductive framework embedding DTB sites of polar Co_{0.85}Se and Co@NC clusters has been demonstrated as a promising interlayer for Li-S batteries.
- The merits of strong binding affinity through Co-S bonds by Co metal catalysis and Li-Se bonds by polar Co_{0.85}Se sites with LiPSs, a short ion-transport path, and abundant catalytically active sites to accomplish a highly efficient LiPS confinement-catalysis process, thereby achieving almost no shuttle effect and fast redox reaction kinetics of LiPSs.
- The Li-S cells with a Co/Co_{0.85}Se@NC-modified separator exhibit a high reversibility of 932 mAh g⁻¹ after 200 cycles at 0.5 C (78% capacity retention), high rate capabilities of 940 and 849 mAh g⁻¹ at 2 and 3 C, respectively, and an ultralow decay rate of 0.042% per cycle over 1000 cycles at 2 C.



(from left) Dr. Huifang XU, Dr. Qingbin JIANG, and Prof. Kwun Nam HUI



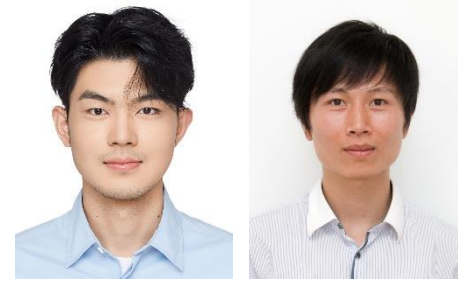
Huifang Xu, Qingbin Jiang, Kwan San Hui,* Shuo Wang, Lingwen Liu, Tianyu Chen, Yunshan Zheng, Weng Fai Ip, Duc Anh Dinh, Chenyang Zha, Zhan Lin, Kwun Nam Hui*, “Interfacial “Double-Terminal Binding Sites” Catalysts Synergistically Boosting the Electrocatalytic Li₂S Redox for Durable Lithium-Sulfur Batteries.” *ACS Nano* 2024, 18, 8839-8852. DOI: 10.1021/acsnano.3c11903. [2023 IF=15.8]

Prof. Kwun Nam HUI is the corresponding author of this study. The first authors are Ms. Huifang XU, Mr. Qingbin JIANG, two Ph.D. students in the IAPME. This work was supported by the Science and Technology Development Fund (FDCT) of Macao SAR (0033/2023/ ITP1, 0022/2023/RIB1, 046/2019/AFJ, 0007/2021/AGJ, 006/2022/ALC, and 0070/2023/AFJ), the Macau Young Scholars Program (AM2020005), Guangdong Basic and Applied Basic Research Foundation (2022A1515110994 and 2022A0505030028), the Multi-Year Research Grants (MYRG2020-00187-IAPME and MYRG2022-00223-IAPME) from the Research Services and Knowledge Transfer Office at the University of Macau, UEA funding, and the HighPerformance Computing Cluster (HPCC) of Information and Communication Technology Office (ICTO) at the University of Macau.

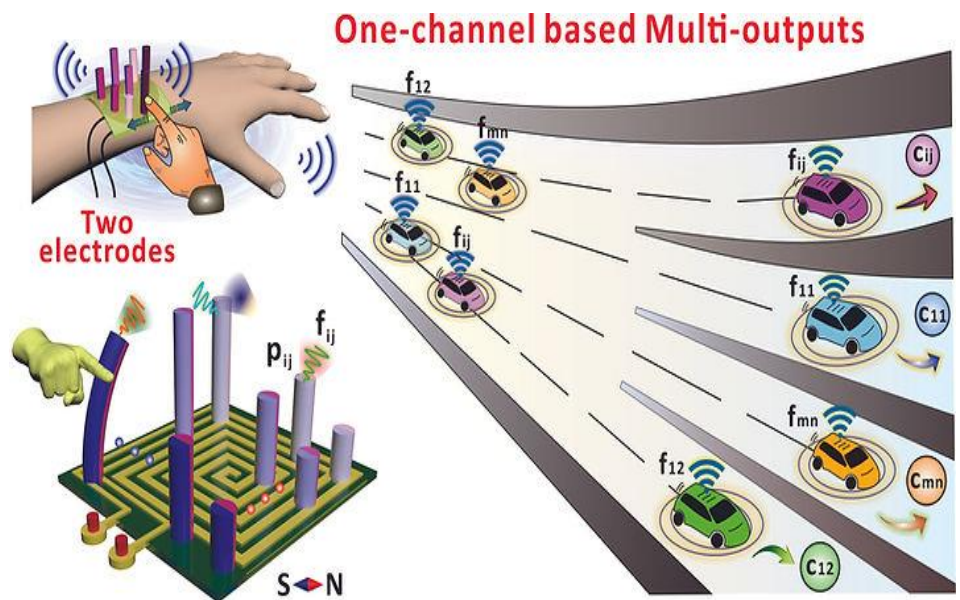
❖ Research Stories

UM research team successfully develops interference-free and self-powered human-machine interactive interface

- A one-channel based self-powered HMI interface, which uses the eigenfrequency of magnetized micropillar (MMP) as identification mechanism, is reported.
- When manually vibrated, the inherent recovery of the MMP causes a damped oscillation that generates current signals because of Faraday's Law of induction. The time-to-frequency conversion explores the MMP-related eigenfrequency, which provides a specific solution to allocate diverse commands in an interference-free behavior even with one electric channel.
- A cylindrical cantilever model is built to regulate the MMP eigenfrequencies via precisely designing the dimensional parameters and material properties. It is shown that using one device and two electrodes, high-capacity HMI interface can be realized when the magnetic micropillars (MMPs) with different eigenfrequencies have been integrated.



(from left) Dr. Sen DING and Prof. Bingpu ZHOU



Schematic diagram of the flexible interface for high-capacity human machine interactions.

Sen Ding, Dazhe Zhao, Yongyao Chen, Ziyi Dai, Qian Zhao, Yibo Gao, Junwen Zhong, Jianyi Luo, and **Bingpu Zhou***, "Single channel based interference-free and self-powered human-machine interactive interface using eigenfrequency-dominant mechanism", *Advanced Science* 2024, 2302782.

DOI:10.1002/advs.202302782 [2023 IF=14.3]

Prof. Bingpu ZHOU is the corresponding author of this study. The first author is Dr. Sen DING, a Ph.D. graduate in the IAPME. This project was funded by the Science and Technology Development Fund, Macau SAR (file no. FDCT-0088/2021/A2, and FDCT-006/2022/ALC), the Guangdong Science and Technology Department (2022A0505030024), the University of Macau (MYRG2022-00006-IAPME), and the Key Technology Project of Shenzhen Science and Technology Innovation Commission (202011023000417).



❖ Commencement High Table in MCM College

On the evening of 24 September 2024, MCM College Master of University of Macau, Professor Kwok-cheung, CHEUNG welcomed distinguished guests, freshmen and upper-classmen to a traditional Commencement High Table 'Gaudie'.



As distinguished keynote speakers, Prof. Wei GE, Vice Rector (Research) and Prof. Handong SUN, MCMC Senior Fellow, Distinguished Professor, Institute of Applied Physics and Materials Engineering, gave thought-provoking and inspiring speeches, which covered knowledge integration, and the significance of collaborating with others to work as a team in areas of the science and social science, as well as in today's fast-changing world.





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Prof. Zikang TANG, Chair Professor, Institute of Applied Physics and Materials Engineering, also attended the event as an esteemed Guest of Honor.





❖ Plaque Unveiling Ceremony for the Joint Laboratory of Precision Nanomedicine

The University of Macau (UM) and the Institute for Research and Innovation in Health (i3S) of Portugal held a collaboration agreement signing ceremony and a plaque unveiling ceremony for the Joint Laboratory of Precision Nanomedicine on 26 September 2024. The laboratory will integrate the academic strengths and research resources of both parties in the field of precision nanomedicine, undertake interdisciplinary research projects, cultivate top-notch research talent, and deepen cooperation between Macao and Portugal in related fields.

Prof. Songnan QU, as the representative of IAPME, attended the Plaque Unveiling Ceremony as well.





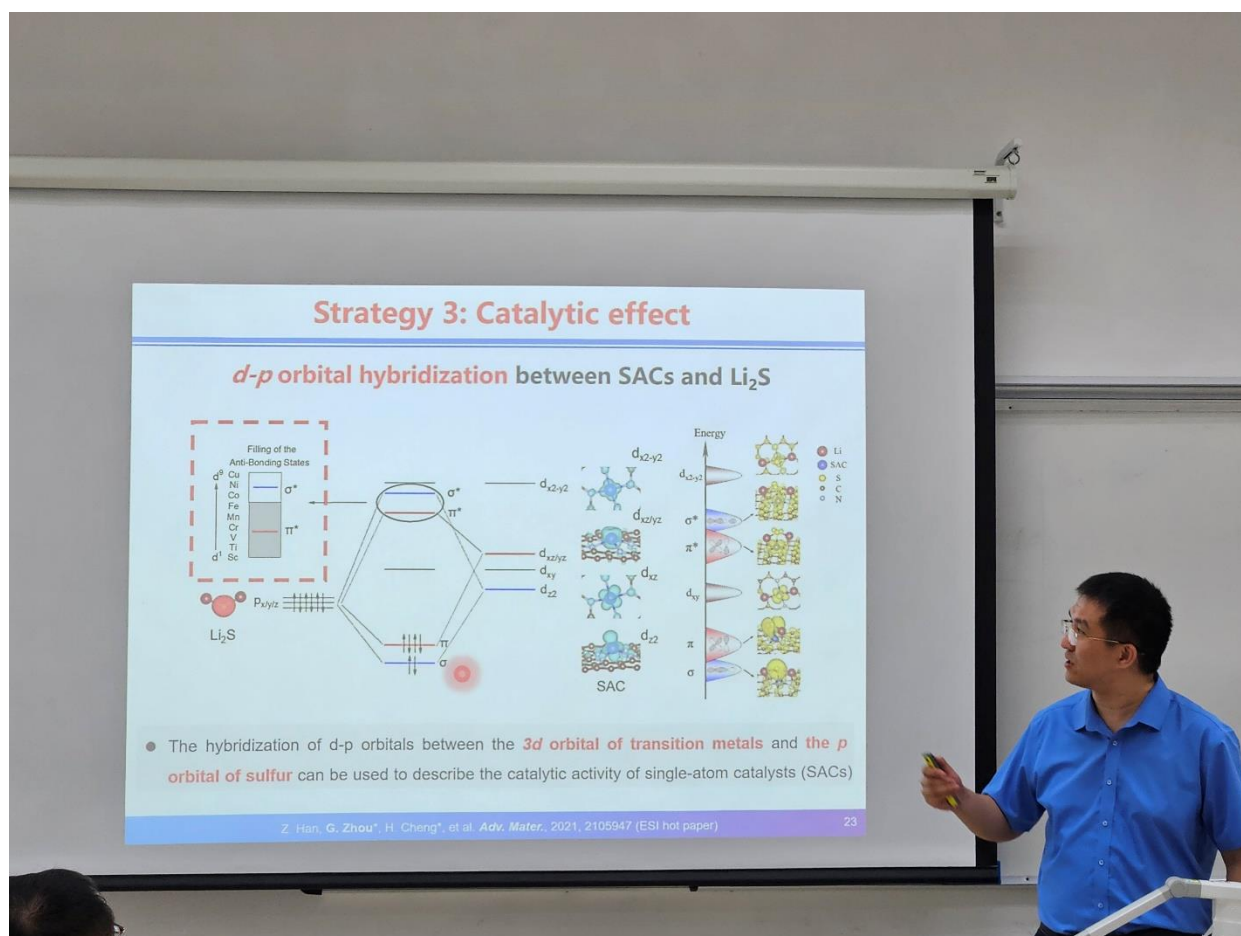
❖ Seminars

Invited by Prof. Guoxing SUN, Prof. Liang CHENG from Institute of Chemistry, Chinese Academy of Sciences gave a talk on “Construction of polymeric structures and their biological applications” on 26 September 2024. In his talk, he introduced the multifunctionality of polymer structures in biological applications. He discussed the latest advancements in the design and utilization of these structures, including polymeric peptides as RNA-degrading ribonuclease mimics, the preparation of polymeric ribonucleotides for the CRISPR/Cas system, and the enhancement of the stability of covalent organic frameworks (COFs). The tunable properties of these polymers make them suitable for a variety of biological applications.



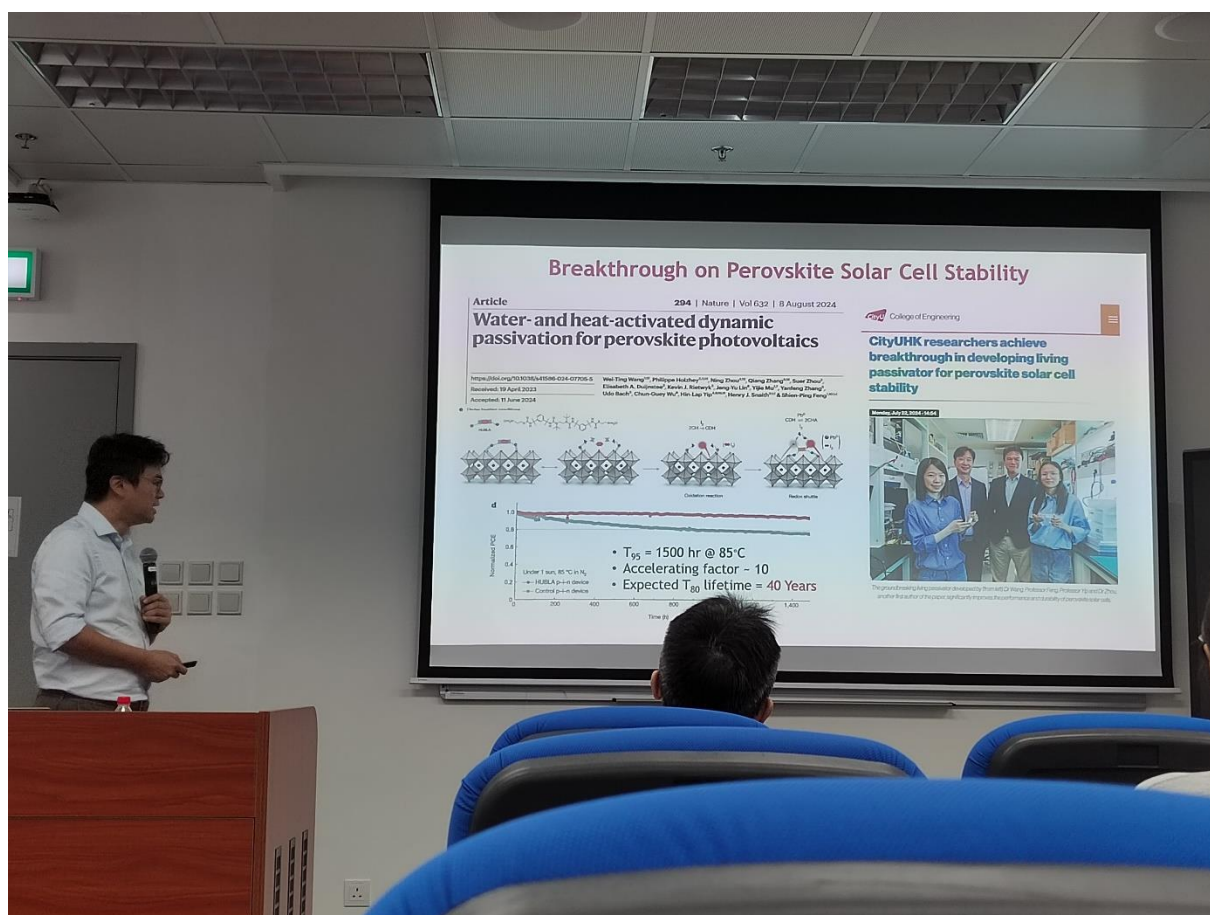
❖ Seminars

Invited by Prof. Kwun Nam HUI, Prof. Guangmin ZHOU from Tsinghua Shenzhen International Graduate School, delivered a talk titled "Design of High-Energy Density Lithium-Sulfur Batteries" at the Institute of Applied Physics and Materials Engineering on 27 September 2024. During the seminar, Prof. Zhou highlighted the potential of lithium-sulfur (Li-S) batteries as a pioneering technology in high-energy density secondary batteries, addressing challenges such as the shuttle effect and slow kinetics. His presentation delved into essential material and device innovations crucial for advancing Li-S batteries, emphasizing a detailed approach to cathode catalyst design. Prof. Zhou also explored the application of machine learning for efficient catalyst screening to enhance battery performance through spin and orbital manipulation, leading to the development of high-sulfur-loading electrodes and pouch cells with energy densities exceeding 400 Wh kg^{-1} .



❖ Seminars

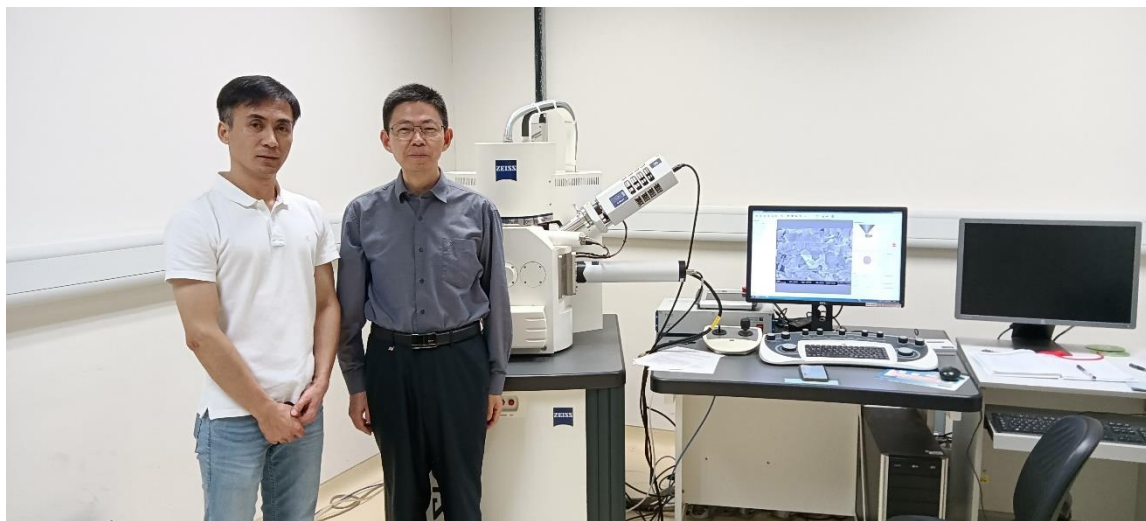
Invited by Prof. Guichuan XING, Prof. Angus Hin-Lap YIP from City University of Hong Kong, delivered a talk titled “Beyond Perovskite Solar Cells: Can Perovskite LEDs Lead the Way in Lighting, Communication, and Lasing Applications?” at the Institute of Applied Physics and Materials Engineering on 27 September 2024. During the seminar, Prof. Angus briefly introduced their works on metal-halide perovskites for light harvesting and light emission applications. He mainly outlined their strategies to control perovskite dimensions and nanostructures using small molecules with tailored functional groups as well as interface engineering techniques borrowed from organic solar cells, leading to developing high performance perovskite solar cells and organic/perovskite tandem solar cells. Afterwards, Prof. Angus also answered questions from the audience and had a lively discussion with everyone.





❖ Visits

Invited by Prof. Hui PAN, Prof. Hongbo SHAN, Dean and Professor of the College of Mechanical Engineering from Donghua University (Shanghai, China), visited IAPME on 26 September 2024. A fruitful discussion between IAPME members and Prof. Shan is conducted, it covers the collaborations on various topics, such as jointed project, student exchange programme, and co-organized workshop. Prof. Shan also visited IAPME' labs, such as the materials characterization facilities.



Contact Us



Email
iapme.enquiry@um.edu.mo

