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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✧ Content

❖ Ph.D. Student Thesis Oral Defenses

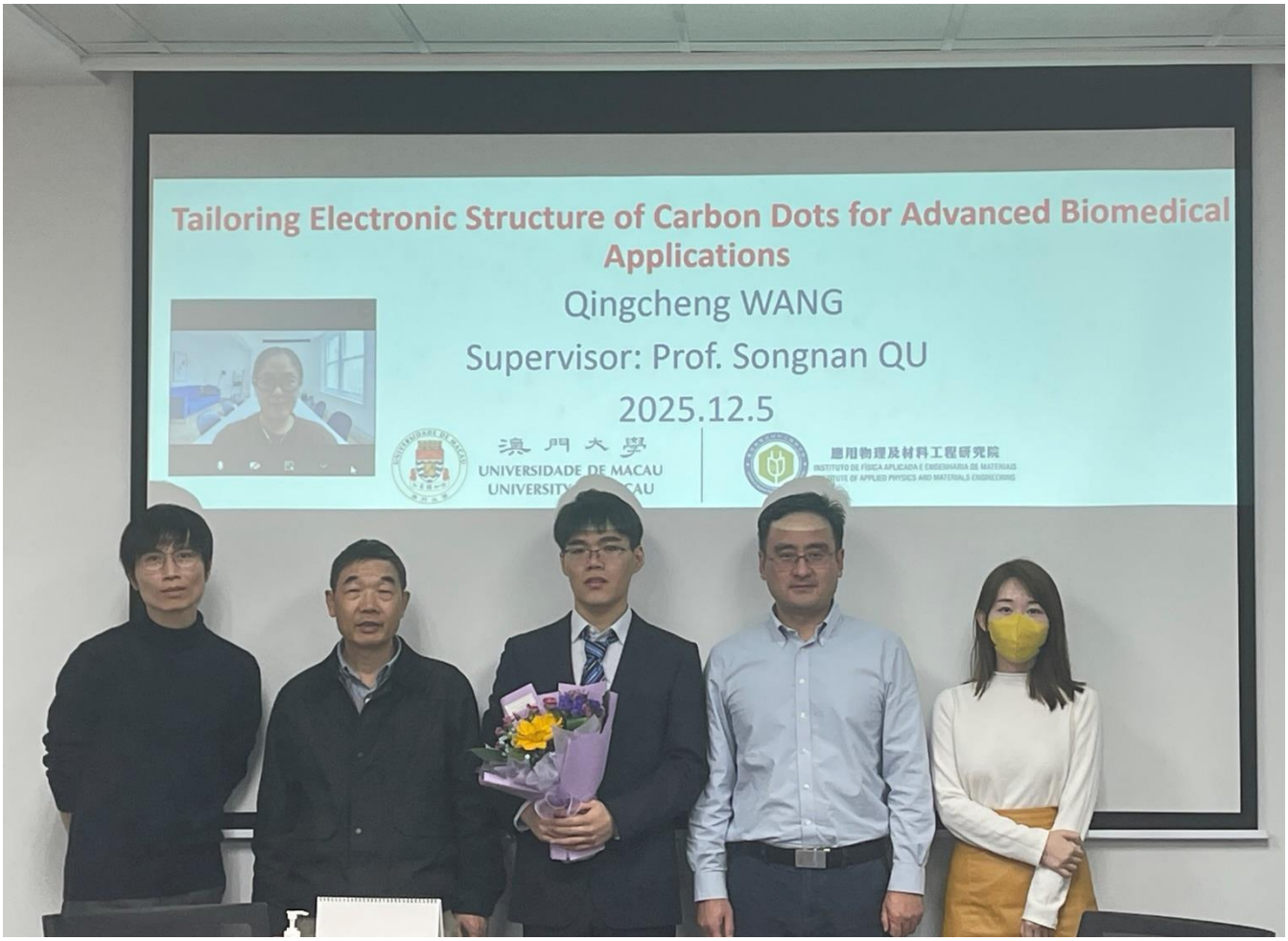
Quansheng Cheng of Prof. Songnan Qu & Prof. Yinning Zhou's group presented "Research on Photocatalytic Carbon Dot-Based Cancer Pyroptosis Therapy" in his oral defense on December 5, 2025.

Congratulations to Dr. Quansheng Cheng!

(from left) Prof. Bingpu Zhou (周冰朴), Prof. Guoxing Sun (孫國星) , Prof. Songnan Qu (曲松楠), Dr. Quansheng Cheng (程全勝), Prof. Handong Sun (孫漢東), Prof. Yinning Zhou (周胤寧) and Prof. Di Li (李迪, JLU)

Qingcheng Wang of Prof. Songnan Qu's group presented "Tailoring Electronic Structure of Carbon Dots for Advanced Biomedical Applications" in his oral defense on December 5, 2025.

Congratulations to Dr. Qingcheng Wang!



(from left) Prof. Bingpu Zhou (周冰朴), Prof. Handong Sun (孫漢東), Dr. Qingcheng Wang (王青城), Prof. Songnan Qu (曲松楠), Prof. Yinning Zhou (周胤寧) and Prof. Di Li (李迪, JLU)

❖ Seminar Series

On December 3, 2025, our Institute hosted a significant Seminar Series event featuring two distinguished scholars: Prof. Zhengwu Jiang (蔣正武), Professor and Doctoral Supervisor at Tongji University, and Prof. Bing Chen (陳兵), Tenured Professor and Doctoral Supervisor at Shanghai Jiao Tong University. The event was organized and hosted by Prof. Guoxing Sun, who extended invitations to both speakers.

Prof. Zhengwu Jiang delivered a compelling presentation titled "*Carbon-Negative Building Materials Production by CO_2 Mineralization of Alkaline Industrial Residues: Design, Reaction Mechanism, and Industrial Applications*". His lecture addressed the growing importance of carbon-negative building materials for advancing solid waste resource utilization and achieving carbon neutrality in the cement and concrete industry. During the seminar, he outlined three critical technical challenges—strength formation, production process, and durability—and shared innovative solutions such as cementitious system design and process parameter optimization. He also presented evidence of successful industrial-scale implementation through a 10,000-tonne demonstration project in the coal chemical sector, underscoring the practical viability of CO_2 sequestration and high-value utilization of solid waste.

A distinguished scholar in building materials research, Prof. Jiang has authored over 400 academic papers, including more than 100 indexed by SCI and EI, with his work cited over 4,000 times. He holds more than 60 national invention patents and has filed over 50 additional patent applications as the first applicant. His pioneering contributions have earned him numerous prestigious awards, solidifying his reputation as a leader in sustainable construction technologies. The seminar offered attendees an in-depth perspective on the latest advancements in sustainable cement-based materials, high-performance concretes, and specialized building solutions, reinforcing our Institute's commitment to promoting innovation in green construction.

Prof. Bing Chen followed with an in-depth presentation titled "*Research on the Mechanism of Mineral Additives in Magnesium Phosphate Cement System*". His talk explored the unique properties of magnesium phosphate cement (MPC), including its rapid setting, high early strength, and strong adhesion—qualities that make it suitable for rapid repair and grouting applications. He also addressed key challenges such as poor water resistance, high cost, and difficulty in controlling setting time, proposing innovative solutions through mineral admixtures like fly ash, ground granulated blast furnace slag (GGBS), and nano-silica. These additives, he explained, enhance MPC's workability, strength, and durability through combined physical and chemical mechanisms.

Prof. Chen is a leading figure in materials engineering, specializing in cement and concrete research. His academic contributions include over 250 published papers, with more than 200 indexed by SCI and 17,000 non-self citations. He has directed over 30 research projects, securing RMB 9 million in funding, and holds 27 authorized invention patents across domestic and international jurisdictions. His achievements have earned him eight major awards, including the Shanghai Science and Technology Progress Award and the Huaxia Construction Science and Technology Award. The seminar also provided insights into the development of thermal insulation and humidity-regulating wall materials based on the micro–nano pore structures of natural materials, offering attendees a comprehensive view of cutting-edge advancements in sustainable construction technologies.

The event offered attendees cutting-edge insights into sustainable building materials, reinforcing our Institute's commitment to innovation in green construction.

On December 4, 2025, our Institute was pleased to host Prof. Quan Xu (許全) from Tianjin University for an engaging seminar titled "*Meta-Optics Empowered Terahertz Devices*". The event was organized by Prof. Hongchao Liu as part of IAPME's ongoing Seminar Series.

Prof. Xu, an Associate Professor at the School of Precision Instruments and Optoelectronics Engineering, Tianjin University, earned his Ph.D. from the same institution in 2019. His academic journey includes research visits to leading global institutions such as King Abdullah University of Science and Technology (KAUST) in Saudi Arabia and the University of Birmingham in the UK. His research focuses on terahertz photonics and meta-devices, particularly on leveraging meta-optical surfaces to manipulate terahertz waves.

In his presentation, Prof. Xu emphasized the strategic importance of terahertz waves, which occupy the spectrum between infrared and microwaves, for next-generation technologies like 6G communications. He introduced meta-optics, a field that employs artificial microstructures to control light, as a transformative approach for managing these complex waves. The seminar highlighted two key categories of innovative devices:

1. Free-Space Manipulation Devices — Including ultra-thin waveplates, lenses, and holographic plates designed to efficiently control terahertz waves in open environments.
2. Integration Devices — Bridging free-space terahertz waves with on-chip systems, paving the way for compact, multifunctional hardware essential for future 6G applications.

The session concluded with a dynamic Q&A discussion, where participants explored practical challenges, material considerations, and commercialization prospects for terahertz technologies.

On December 4, 2025, our Institute welcomed Prof. Zhiyuan Zeng (曾志遠), Associate Professor in the Department of Materials Science and Engineering at City University of Hong Kong, for an academic seminar titled "*Intercalation in 2D Materials and In-Situ Studies*". The event was hosted by Prof. Guichuan Xing and drew faculty members, researchers, and students with interests in advanced materials and nanotechnology.

In his presentation, Prof. Zeng introduced his research group's pioneering lithium-ion intercalation and exfoliation method for the scalable production of high-quality two-dimensional transition metal dichalcogenides (TMDs). He explained how precise electrochemical control enables selective synthesis of specific phases—such as 2H bilayer or 1T′ monolayer WS_2—with yields exceeding 90%.

In addition, Prof. Zeng showcased the use of in-situ liquid-phase transmission electron microscopy to visualize intercalation dynamics and discussed the environmental potential of metallic-phase TMDs in heavy metal removal and water desalination.

Prof. Zeng is widely recognized as a leading figure in materials science, with over 176 SCI-indexed publications, including articles in Nature Reviews Chemistry and Nature Protocols. He has also been named a Highly Cited Researcher, underscoring his influence in the field. His visit provided valuable insights for UM researchers and opened avenues for future collaboration in materials science and environmental technology.

On December 5, 2025, our Institute hosted a significant academic seminar featuring two distinguished experts in biomedical engineering and healthcare innovation: Dr. Mingxuan Song (宋明軒) from the Suzhou Institute of Biomedical Engineering and Technology, and Prof. Xinzui Wang (王心醉) from Jihua Laboratory. The event was chaired by Prof. Songnan Qu, who extended invitations to both speakers.

Dr. Mingxuan Song delivered a thought-provoking lecture titled "*Integration and Development Trends of Mainland Medical Device Industry with Next-Generation AI Technology*". Dr. Song currently serves as Secretary-General of the CAS Advanced Medical Device Industry Incubation Alliance and holds multiple leadership roles, including Chairman and General Manager of Suzhou CAS Medical Device Industry Development Co., Ltd.—the only directly invested medical device incubation company under China Holdings Group of the Chinese Academy of Sciences (CAS). He is also President of the Group Corporation of the Suzhou Institute of Biomedical Engineering and Technology (SIBET), CAS.

In his presentation, Dr. Song provided a comprehensive analysis of the current status, driving forces, challenges, and strategic development directions for the deep integration of Mainland China's medical device industry with next-generation artificial intelligence (AI) technologies. He addressed audience concerns regarding regulatory frameworks for AI in medical diagnostics, outlining ongoing efforts to ensure patient safety while fostering innovation in this rapidly evolving sector. The seminar offered attendees valuable insights into the intersection of biomedical engineering and AI, highlighting opportunities for collaboration and innovation in advancing healthcare technologies.

Prof. Xinzui Wang followed with a distinguished lecture titled "*Integrated Solution for TCM-Based Intelligent Elderly Care and Health-Preserving Platform*". Prof. Wang is a Researcher and Doctoral Supervisor, serving as Director of the Institute of Biomedical Engineering Technology and Member of the Party Committee at Jihua Laboratory. His accolades include selection into the Youth Innovation Promotion Association of the Chinese Academy of Sciences (2015), recognition as Foshan City's "Most Beautiful Science and Technology Worker" (2023), and the Second Prize of the Guangdong Provincial Science and Technology Progress Award (2022). Prof. Wang also holds leadership roles in several provincial and municipal medical associations focused on medical AI, medical-engineering integration, translational medicine, and technology evaluation.

In his lecture, Prof. Wang outlined the core technology framework of the TCM-integrated intelligent elderly care platform. He explained the technical logic behind integrating "TCM theory – engineering technology – elderly care services" and demonstrated how multi-modal data fusion enables a full-chain system encompassing physiological monitoring, intelligent nursing, rehabilitation evaluation, and service scheduling. Prof. Wang also introduced his team's latest innovation—a multi-functional intelligent nursing system combining bed and chair equipment, designed to enhance elderly care through smart, adaptive solutions. The session provided attendees with a forward-looking perspective on combining traditional Chinese medicine principles with cutting-edge engineering technologies, paving the way for intelligent healthcare solutions tailored to aging populations.

The two lectures provided a comprehensive outlook on the convergence of advanced AI technologies with medical device innovation and the integration of traditional Chinese medicine into intelligent elderly care systems. These discussions highlighted strategic pathways for future healthcare development and reinforced our Institute's commitment to fostering interdisciplinary collaboration.

❖ Cheers to the Season! IAPME Christmas Gathering 2025

On December 5, 2025, IAPME celebrated the holiday season by hosting the "IAPME Christmas Party 2025" at Beverly Seafood Restaurant. The event brought together nearly 30 staff members and their families for an evening filled with joy.

The celebration began with warm remarks from two Associate Directors, Prof. Handong Sun and Prof. Hui Pan, who extended heartfelt wishes for a Merry Christmas to all attendees. Everyone then indulged in a sumptuous feast featuring a variety of delicious dishes.

Adding to the festive spirit, the evening featured entertaining games and an eagerly anticipated lucky draw, creating moments of excitement and laughter. The atmosphere was vibrant and cheerful as everyone enjoyed the holiday festivities together.

❖ Upcoming Events

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IAPME Seminar

Multiscale hybrid design to tune catalyst activity

18 December 2025
Prof. Xingke CAI
Shenzhen University
Venue: N23-4018
Time: 10:30 - 11:30
Hosted by: Prof. Qing LI

Abstract

Multi-electron electrocatalytic reactions usually suffer from sluggish kinetics, leading to high over-potentials and low energy-conversion efficiencies. The reaction kinetics are directly governed by the activity of the catalyst. In this presentation, I will talk about our strategies to accelerate kinetics by tuning the electronic structure of active sites with heteroatoms. Through materials design, three levels of increasing structural precision, i.e. interfacial hybridization, intrinsic doping and atomically precise hybridization, have been implemented and validated.

Biography

Prof. Xingke CAI is currently as a Professor in Shenzhen University. He has published 55 first/corresponding author papers in top-tier journals, such as Nat. Nanotechnol. Nat. Commun., Adv. Mater., Chem. Soc. Rev., J. Am. Chem. Soc, with over 5000 citations. His research mainly focuses on the preparation of two-dimensional oxides/hydroxides and their applications.

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