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

❖ Publications (IF≥10; *corresponding author)

1. **Wenxue Dai**, Ming Lei, Ziyi Dai, Sen Ding, Fangcheng Wang, Dan Fang, Rongmei Wang, Biao Qi, Guoping Zhang,* and **Bingpu Zhou*** . Self-Adhesive Electronic Skin with Bio-inspired 3D Architecture for Mechanical Stimuli Monitoring and Human-machine Interactions. *Small,* 2:e2406564 (2024). DOI: 10.1002/smll.202406564. [2023 IF=13.0]

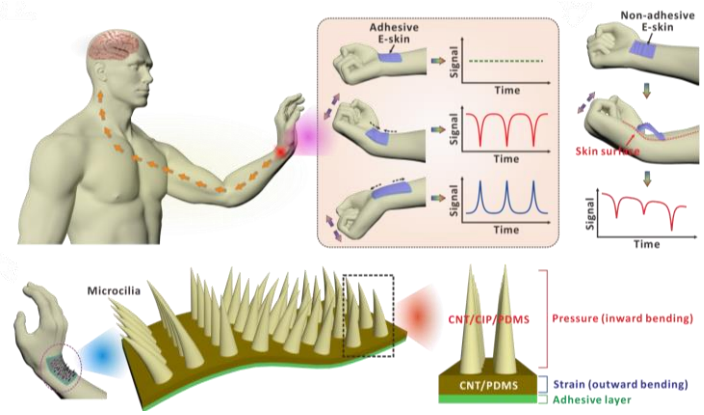
❖ Research Stories

UM research team successfully develops self-adhesive electronic skin with bio-inspired 3D architecture for mechanical stimuli monitoring

- An adhesive E-skin that can firmly attach on the human skin for mechanical stimuli perception is reported.
- The laser-induced adhesive layer serves as the essential component to ensure the conformal attachment of E-skin on curved surface, which ensures the accurate conversion from mechanical deformation to precise electrical readouts. Especially, the 3D architecture facilitates the non-overlapping outputs for bi-directional joint bending and perception of strain/pressure.
- The optimized E-skin with bio-inspired micro-cilia exhibited significantly improved sensing performances. Furthermore, the adhesive E-skin can distinguish inward/outward joint bending in non-overlapping behaviors, allowing the establishment of ternary system to expand communication capacity for logic outputs such as effective Morse code and intelligent control.

Dr. Wenxue Dai

Prof. Bingpu Zhou



Sensing mechanism of the HMI system based on adhesive E-skin and schematic diagram of E-skin with micro-cilia on top.

Wenxue Dai, Ming Lei, Ziyi Dai, Sen Ding, Fangcheng Wang, Dan Fang, Rongmei Wang, Biao Qi, Guoping Zhang,* and **Bingpu Zhou*** . Self-Adhesive Electronic Skin with Bio-inspired 3D Architecture for Mechanical Stimuli Monitoring and Human-machine Interactions. *Small,* 2:e2406564 (2024). DOI: 10.1002/smll.202406564. [2023 IF=13.0]

Prof. Bingpu Zhou is the corresponding author of this study. The first authors is Wenxue Dai , a Ph.D. student in the IAPME. This work was supported by The Science and Technology Development Fund, Macau SAR (file no. FDCT-0088/2021/A2, and FDCT-006/2022/ALC), the National Natural Science Foundation of China (62174170), the Natural Science Foundation of Guangdong Province (2024A1515010123), the Strategic Priority Research Program of the Chinese Academy of Sciences (XDB0670000), the Shenzhen Science and Technology Program (KJZD20230923114708018, KJZD20230923114710022), the Talent Support Project of Guangdong (2021TX06C101) and the Shenzhen Basic Research (JCYJ20210324115406019).

❖ Ph.D. Student Thesis Oral Defenses

Hao Gu of Prof. Guichuan Xing's group presented "Metal-Halide Perovskite Phase Modulation for Efficient and Stable Perovskite Solar Cells" in his oral defense on October 21, 2024.

Congratulations to Dr. Hao Gu!

(from left) Prof. Yongqing Cai, Prof. Shi Chen, Prof. Guichuan Xing, Dr. Hao Gu, Prof. Zonglong Zhu(CUHK) and Prof. Hui Pan

❖ The University of Macau Actively Participates in the Joint Construction of the Southern Advanced Photon Source

On October 26, 2024, the third meeting of the Southern Advanced Photon Source Steering Committee was held in Hong Kong. This meeting marked a significant step forward in technological innovation cooperation within the Guangdong-Hong Kong-Macao Greater Bay Area. Eight universities from Hong Kong and Macao, including the University of Macau, jointly signed a framework agreement aimed at promoting the construction and development of the Southern Advanced Photon Source.

The Southern Advanced Photon Source project is a planned fourth-generation diffraction-limited synchrotron radiation source in the Greater Bay Area, aiming to become a world-leading scientific research facility. This project will provide powerful experimental support for research in multiple fields such as materials science, chemical engineering, energy, environment, and biomedicine. As a key participant in this collaboration, the University of Macau will play a crucial role in the design, construction, and operation of the project.

Director Sheng Wang (right) of the Southern Advanced Photon Source and Prof. Hai-feng Li (left), representing the University of Macau, signed a cooperation agreement to meet the University of Macau users' needs for a world-class fourth-generation synchrotron radiation source facility.

In this collaboration, the University of Macau demonstrated its outstanding capabilities in scientific research and technological development. Prof. Hai-feng Li, representing the University of Macau, stated at the meeting that the University of Macau will make full use of this cooperation opportunity to further strengthen ties with other universities and research institutions, promote interdisciplinary research, and facilitate the transformation and application of scientific and technological achievements. The participation of the University of Macau not only helps enhance its influence in the international academic community but also provides new opportunities for higher education and research cooperation in the Greater Bay Area.

Moreover, the active participation of the University of Macau reflects its commitment to promote regional technological development. Through its involvement in the construction of the Southern Advanced Photon Source, the University of Macau is dedicated to cultivate high-level research talent and advancing industrial upgrading and technological innovation in the Greater Bay Area. The successful implementation of this project will inject new vitality into the economic development of Macao and the entire Greater Bay Area.

The successful convening of this meeting marks the commencement of the substantive advancement phase of the Southern Advanced Photon Source project. The University of Macau, along with other partners, will jointly explore new models to meet the needs of Greater Bay Area users for world-class research facilities and set a benchmark for technological innovation cooperation in the Guangdong-Hong Kong-Macao Greater Bay Area. In the future, with the completion of the Southern Advanced Photon Source, the University of Macau will play an even greater role in international technological innovation cooperation, contributing to scientific research both regionally and globally.

The Southern Advanced Photon Source signed a cooperation agreement with Hong Kong and Macao universities to meet the needs of users in the Guangdong-Hong Kong-Macao Greater Bay Area for a world-class fourth-generation synchrotron radiation source facility.

❖ IAPME co-hosted the 2024 Mainland-Macau Advanced Materials Symposium in Beijing

Recently, IAPME, School of Materials, Beijing Institute of Technology, and Macao Institute of Materials Science and Engineering of Macau University of Science and Technology co-hosted the "2024 Mainland-Macau Advanced Materials Symposium." The symposium was held on October 11-13, 2024, at the Beijing Institute of Technology.

The symposium provided a platform for young researchers to exchange ideas, broaden their academic horizons, and enhance research capabilities in advanced materials.

Prof. Shuangpeng Wang, Associate Professor of IAPME, served as the Vice-Chair of the symposium. Prof. Handong Sun, Prof. Songnan Qu, Dr. Peili Gao, Dr. Jiahao Xiong, and Dr. Hao Lin attended and gave presentations at the event.

Prof. Handong Sun delivered a plenary speech

Dr. Hao Lin (second from left) was awarded the Outstanding Youth Speech

❖ Guangdong-Hong Kong-Macao University Alliance for Hydrogen Energy Innovation Launched

On October 17, 2024, the kick-off meeting for "Guangdong-Hong Kong-Macao University Alliance for Hydrogen Energy Innovation" was held at Foshan University. Prof. Shuangpeng Wang, Associate Professor of IAPME, signed the "Agreement on the Establishment of the Guangdong-Hong Kong-Macao University Alliance for Hydrogen Energy Innovation" on behalf of the University of Macau and delivered a keynote speech titled "Electrocatalysts for Water Splitting: From Design, Fabrication to Industrial Production."

The representatives signed the agreement

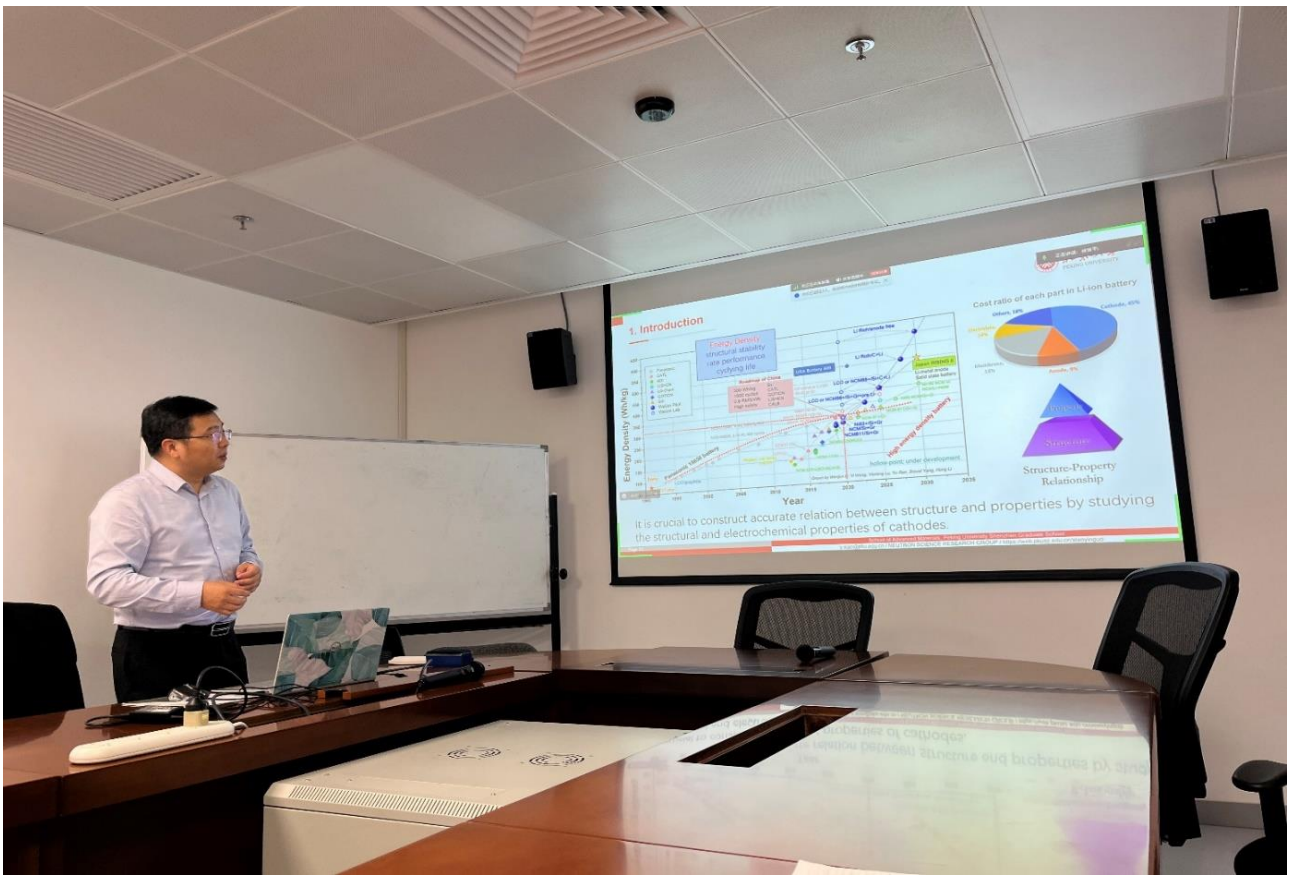
Prof. Shuangpeng Wang delivered a keynote speech

To meet the development needs of the hydrogen energy industry in Guangdong Province and the Greater Bay Area, the "Guangdong-Hong Kong-Macao University Alliance for Hydrogen Energy Innovation" was initiated by Foshan University, South China University of Technology, Hong Kong University of Science and Technology, and the University of Macau and officially approved in July 2024.

The alliance will strengthen cooperation and exchange in the fields of new energy and hydrogen energy among Guangdong, Hong Kong, and Macao, and promote resource, information, and achievement sharing. The goal is to build a world-class platform to deepen scientific research, talent cultivation, technological innovation, project cooperation, and achievement transformation, thereby advancing the integration of innovation and industrial chains and promoting high-quality development of the hydrogen energy industry in the Greater Bay Area.

❖ Seminars

Invited by Prof. Hai-Feng Li, Prof. Yinguo Xiao from Peking University Shenzhen Graduate School delivered a talk on "Exploration and Optimization of the Structural Properties of Cathode Materials Using Neutron Scattering Methods" on October 25, 2024. In his presentation, he introduced the origin of neutrons, the principles of scattering, and the application of neutron scattering in battery research. Prof. Xiao's group utilizes ex-situ and in-operando neutron diffraction techniques to investigate the structural characteristics of cathode materials in lithium and sodium-ion batteries, particularly focusing on the real-time structural evolution of cathodes during cycling. In addition to research on cathode materials, he also discussed the construction progress of the Peking University High Resolution Neutron Diffractometer at the China Spallation Neutron Source.



❖ Upcoming Events

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IAPME Seminar

Quantum-dot laser technology: the key for Si-based lasers for Si photonics

8 November 2024
Prof. Huiyun LIU
University College London, UK
Venue: N23-4018
Time: 10:30 - 11:30
Hosted by: Prof. Handong SUN

Abstract

Si is one of the most important semiconductor materials as it has been the mainstays for modern electronics. However, it is not widely used for light emitting sources because Si is an inefficient emitter, a result of indirect bandgap. Direct epitaxial growth of III-V nanostructures on silicon substrates is one of the most promising candidates for realizing photonic devices on a silicon platform. The major issue of monolithic integration of III-V on Si is the formation of high-density threading dislocations. The propagation of TDs will cause high ratio of non-radiative recombination centre in III-V epitaxial active region. To stop the TD propagation, different epitaxial strategies, such as InGa(Al)As strain layer, Ge buffer layers and patterned substrates have been applied and compared in this presentation. As a zero-dimensional material, quantum dots (QDs) have three-dimensional quantum confinements, which create delta-function like density of states. Therefore, III-V QD lasers have low threshold currents, temperature insensitive operation, and less sensitivity to threading dislocations, which are the ideal candidate to form active region in III-V lasers grown on group IV substrates. 1300-nm InAs/GaAs QD lasers grown on Si and Ge substrates have been proposed and developed since 2011 at UCL with long lifetime and high power. In this presentation, the development milestones of InAs/GaAs QD lasers monolithically grown on a Si platform will be summarised, and the potential trend in next few years will also be predicted.

Biography

Prof. Huiyun LIU received his PhD from form Institute of Semiconductor, Chinese Academy of Sciences in 2001. After receiving his PhD, he joined the EPSRC National Centre for III-V Technologies at Sheffield University. In 2007, he was awarded Royal Society University Research Fellow, and started his academic career by taking Senior Lecturer position in the Department of Electronic and Electrical Engineering at University College London with commissioning the first new Molecular Beam Epitaxy reactor in London, and creating a new group. In 2012, he was promoted as Chair Professor of Semiconductor Photonics at University College London. His current research interest concentrates on the nanometre-scale engineering of low-dimensional semiconductor structures by using Molecular Beam Epitaxy and the development of novel optoelectronic devices including lasers, detectors, solar cells, and modulators on Si platform. He co-authored more than 500 papers and hold on several patents on silicon photonics and quantum dot technology.

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