澳門大學
UNIVERSIDADE DE MACAU
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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≥8, and/or Nature Index; *corresponding author)

1. **Yuanzhe Liang**, Biao Qi, Ming Lei, Yingyi Zhang, Yifan Liu, **Yinning Zhou**, Jianyi Luo, and **Bingpu Zhou***. Bionic Perception of Surface Adhesion via Magnetized Spring-like Sensor with Axial Stretchability. *ACS Nano* (2025). DOI: 10.1021/acsnano.5c07356 [2024 IF=16.0]

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Bionic Perception of Surface Adhesion via a Magnetized Spring-like Sensor with Axial Stretchability

Yuanzhe Liang, Biao Qi, Ming Lei, Yingyi Zhang, Yifan Liu, Yinning Zhou, Jianyi Luo, and Bingpu Zhou*

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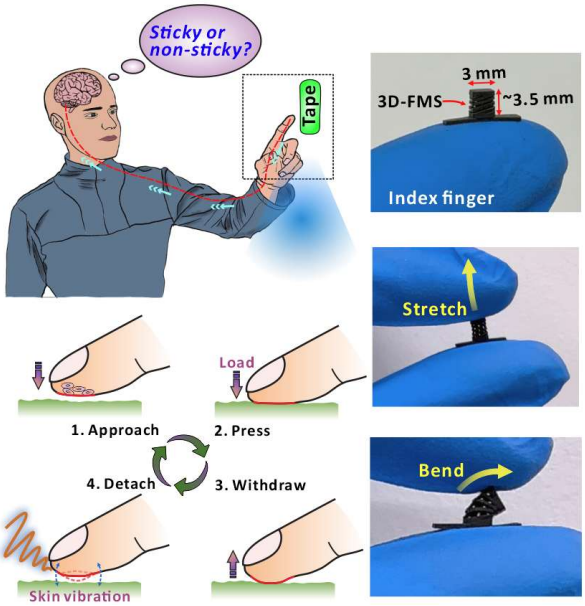
❖ Research Stories

UM research team developed a 3D flexible magnetized spring to realize bionic perception of surface adhesion

- Adhesion can be widely found in nature, as well as in human society. Adhesive perception is important for the robot grasping process.
- Inspired by the daily operations, touch and release, of human fingertips, we reported a three-dimensional flexible magnetized spring (3D-FMS) for surface adhesion perception. Based on the application of unique laser cutting patterns, a flexible spring-like device with tunable stiffness can be realized with excellent longitudinal stretchability.
- As a wearable device, the 3D-FMS could perform like the skins of a human fingertip to undergo a typical compression–elongation–rebound process. When in contact with an adhesive surface, the stretching finally results in spontaneous oscillation once it is separated from the surface. Coupled with the built-in magnetization, the mechanical deformation leads to rapid changes of magnetic flux to induce electrical signals in the coil layer. The peak voltage is related to the degree of elongation. The sensitivity and working range can be flexibly regulated via the stiffness to enable broad applications with specific requirement. The compact size allows the sensor to be equipped with a robotic arm to mimic the in-situ adhesive perception with a fast and reliable response.

Mr. Yuanzhe Liang (梁遠哲)

Prof. Bingpu Zhou (周冰朴)



Schematic diagram of how humans feel surface adhesion via touching a surface, and the developed three-dimensional flexible magnetized spring (3D-FMS) with demonstration of flexibility and stretchability.

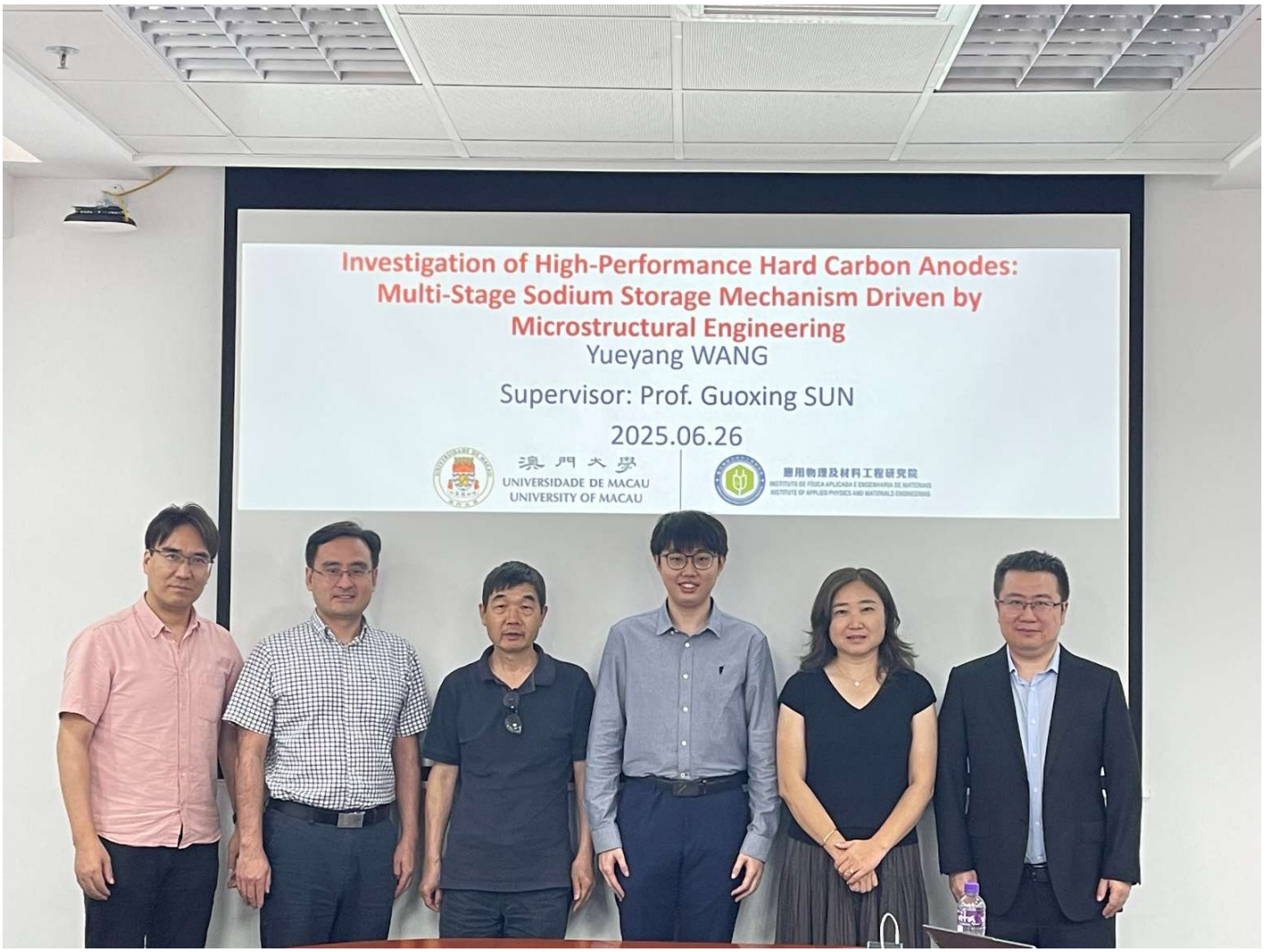
Yuanzhe Liang, Biao Qi, Ming Lei, Yingyi Zhang, Yifan Liu, **Yinning Zhou**, Jianyi Luo, and **Bingpu Zhou***. Bionic Perception of Surface Adhesion via Magnetized Spring-like Sensor with Axial Stretchability. *ACS Nano* (2025). DOI: 10.1021/acsnano.5c07356 [2024 IF=16.0]

Prof. Bingpu Zhou is the corresponding author of this study. The first author is Mr. Yuanzhe Liang, a Ph.D. student in the IAPME. This work was supported by The Science and Technology Development Fund, Macau SAR (0057/2023/RIB2), Macao Centre for Research and Development in Advanced Materials (0002/2024/TFP), Guangdong Science and Technology Department (2022A0505030024), and University of Macau (MYRG2024-00090-IAPME).

❖ Ph.D. Student Thesis Oral Defenses

Yueyang Wang of Prof. Guoxing Sun's group presented "Investigation of High-Performance Hard Carbon Anodes: Multi-Stage Sodium Storage Mechanism Driven by Microstructural Engineering" in his oral defense on June 26, 2025.

Congratulations to Dr. Yueyang Wang!

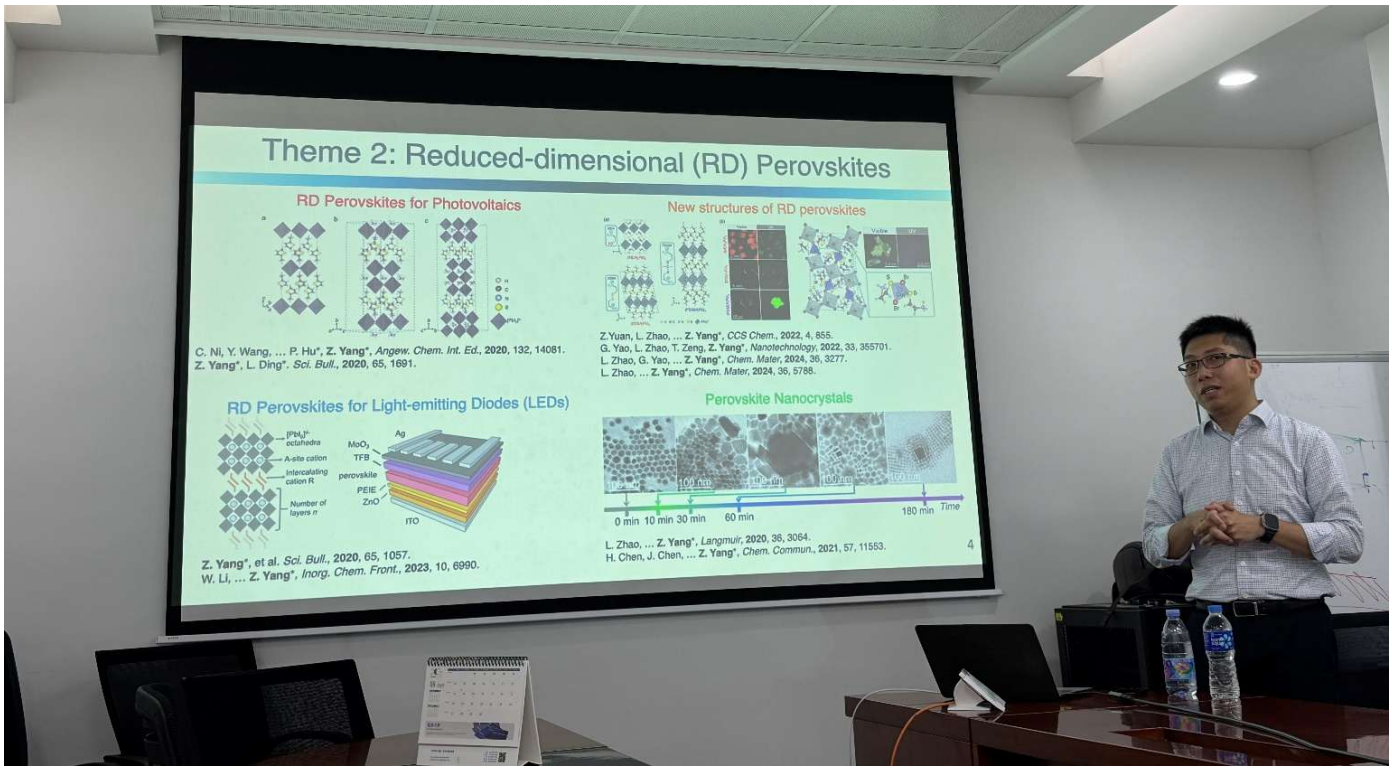


(from left) Prof. Huaiyu Shao (邵懷宇), Prof. Songnan Qu (曲松楠), Prof. Handong Sun (孫漢東), Dr. Yueyang Wang (王月陽), Prof. Qian Zhang (張倩, HITSZ) and Prof. Guoxing Sun (孫國星)

❖ Seminars

Prof. Zhenyu Yang (楊振宇), Professor at School of Chemistry of Sun Yat-sen University, visited IAPME on June 23, 2025. During his visit, he delivered an insightful presentation titled “Ligand Engineering for Modulating the Crystal Structure and Optoelectronic Properties of Two-Dimensional Metal Halide Perovskites”. The seminar was hosted by Prof. Yongqing Cai, who extended the invitation to Prof. Yang.

Prof. Yang obtained his B.Sc. from Nankai University in 2009 and later pursued his Ph.D. at the University of Alberta under the supervision of Prof. Jonathan Veinot, a leading expert in solid-state silicon chemistry. After earning his doctorate in 2014, he joined the laboratory of Prof. Edward Sargent at the University of Toronto as a postdoctoral researcher. His current research focuses on the synthesis and surface chemistry of silicon/germanium semiconductors, as well as the design and optimization of related optoelectronic devices.



During his talk, Prof. Yang highlighted a novel class of organic zwitterionic ligands and related chemical reactions developed by his research group, along with the resulting series of unprecedented 2D perovskite structures. The seminar covered the discovery and development of these ligands and their reactions, their impact on perovskite dimensionality and bonding modes, as well as the optoelectronic properties of the derived materials.

❖ Delegation from Northwestern Polytechnical University Visited IAPME

A delegation from the School of Chemistry and Chemical Engineering at Northwestern Polytechnical University visited the Institute of Applied Physics and Materials Engineering (IAPME) on June 23, 2025. The delegation included student mentors and Bachelor's students. Prof. Shi Chen (陳石), Prof. Bingpu Zhou (周冰朴), and Dr. Mike Chio (趙志康) from IAPME participated in the visit.

During the visit, Prof. Chen provided a detailed overview of IAPME, highlighting the research capabilities, key focus areas, ongoing projects in advanced materials and related applications. The students expressed interests in pursuing graduate studies at IAPME, UM. The students also visited the exhibition hall of IAPME, and raised questions about the research displays.