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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ISSUE 29

09 April 2025

Content

❖ Publications (IF≥10; *corresponding author)

1. **Dan Fang**, Sen Ding, Yuhan Liu, Qian Zhou, Biao Qi, Bing Ji, and **Bingpu Zhou***. Revisiting the "Stick-slip" Process via Magnetism-coupled Flexible Sensors with Bio-inspired Ridge Architecture. *Advanced Materials*, 2417867 (2025). DOI: 10.1002/adma.202417867 [2023 IF=27.4]

ADVANCED MATERIALS

Research Article | Open Access

Revisiting the "Stick-Slip" Process via Magnetism-Coupled Flexible Sensors with Bioinspired Ridge Architecture

Dan Fang, Sen Ding, Yuhan Liu, Qian Zhou, Biao Qi, Bing Ji, Bingpu Zhou

First published: 19 March 2025 | https://doi.org/10.1002/adma.202417867

❖ Research Stories

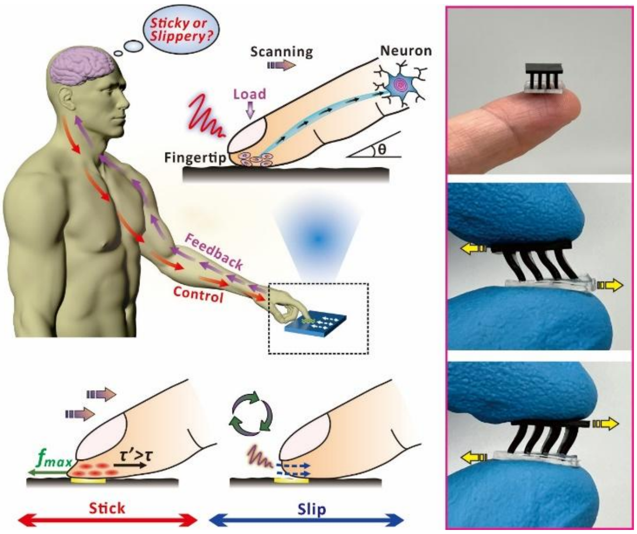
UM research team developed magnetism-coupled flexible sensors with bioinspired ridge architecture for "Stick-Slip" revisiting

- Understanding the "stick-slip" behavior is important for bionic flexible system in applications from advanced robotics to intelligent tactile sensors.

- Inspired by tangential deformation and fast recovery feature of skin in stick-slip detection, the research team initiated and developed a flexible tactile biomimetic sensor comprising a magnetized sandwich-structured layer and flexible copper coils for investigation of stick-slip phenomenon. In the device, a non-magnetized PDMS top layer served as the coil substrate, a magnetized film bottom layer for surface interaction, and a deformable ridge-based structure was encapsulated as intermediate layer.

- During surface scanning with the biomimetic finger, the sensor's flexible ridge undergoes tensile deformation and rapidly recovers when interfacial static friction force between the substrate and surface reaches its maximum value. This rapid recovery induces abrupt magnetic flux variations, generating distinctive current peaks in the fixed top-mounted coil. In continuous sliding process, the cyclic deformation-recovery dynamics produced characteristic electrical peaks, enabling real-time monitoring of stick-slip phenomena that serves as the hint to provide feedback of interfacial information.

(From left) Ms. Dan Fang (方丹) and Prof. Bingpu Zhou (周冰朴)



Schematic diagram of a typical stick-slip process when fingertip scans across a surface, and the developed flexible magnetized sensor to revisit and explore the underlying mechanism

Dan Fang, Sen Ding, Yuhan Liu, Qian Zhou, Biao Qi, Bing Ji, and **Bingpu Zhou***. Revisiting the "Stick-slip" Process via Magnetism-coupled Flexible Sensors with Bio-inspired Ridge Architecture. *Advanced Materials*, 2417867 (2025). DOI: 10.1002/adma.202417867 [2023 IF=27.4]

Prof. Bingpu Zhou is the corresponding author of this study. The first author is Ms. Dan Fang, a Ph.D. student in the IAPME. This work was supported by the Science and Technology Development Fund, Macao SAR (File no. 0057/2023/RIB2), UM's research fund (File no. MYRG-GRG2024-00090-IAPME), and Guangdong Science and Technology Department (File no. 2022A0505030024).

❖ Delegation from municipal department of Wuhu City visited IAPME

A delegation from the municipal department of Wuhu City, led by Mr. Xin Li (李欣), Minister of Organization Department, visited the Institute of Applied Physics and Materials Engineering (IAPME) on March 26, 2025. Prof. Handong Sun, Prof. Guichuan Xing, and Prof. Bingpu Zhou from IAPME, participated in the discussion.

During the visit, Mr. Xin Li provided an overview of the industry in Wuhu City, highlighting the talent policy, outstanding companies and factories, and long-term focus areas. Prof. Handong Sun then introduced IAPME, by detailing our research capabilities, interdisciplinary approach, and ongoing projects in advanced materials and related applications. He also highlighted IAPME's achievements in scientific research and international collaborations, showcased the institute's strength in translating scientific discoveries into practical applications. Especially, both parties exchanged valuable insights and discussed potential areas for collaboration, will be focusing on the solar cell, battery material, green energy, and photonic technologies.

❖ Upcoming Events

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IAPME Seminar

Topological Ideas Implemented with Metamaterials

14 April 2025

Dr. Dongyang WANG
University of Southampton
Venue: N23-4018
Time: 16:00 - 17:00
Hosted by: Prof. Hongchao LIU

Abstract

Topology is a mathematical term to describe the shape of objects, such as the sphere, torus, and even coffee mug. The key idea is to count the number of 'holes' in the geometrical objects, which remains unchanged with smooth deformation. It becomes more interesting when this idea is adopted to characterize materials, i.e., the number of holes becomes the so-called topological invariant, and importantly, the property of being robust against deformation is inherited. In this talk, I will firstly show how the geometrical concept is connected to materials. I will then give a few examples on how topological invariants can be implemented with metamaterials. I will further show that the topological invariants can take the form of matrix and lead to non-Abelian characteristics.

Biography

Dr. Dongyang WANG received his PhD in 2018 from Tianjin University, China, and did his postdoctoral research at the Hong Kong University of Science and Technology from 2019 to 2023. He joined the University of Southampton in United Kingdom as an Anniversary Fellow in October of 2023 and is currently a permanent academic in the Optoelectronics Research Centre. Dr. Wang's research focuses on topological photonics, metamaterials, and terahertz science. His research has led to the discovery of several new topological phases, such as the first photonic magnetic Weyl point, the super-imaging effect with topological metamaterials, and the non-Abelian band topology in general optics.

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❖ Upcoming Events

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IAPME Seminar

Molecular Rare-earth Material Systems for the Applications of Next-generation Photonic Integrated Technologies

16 April 2025

Prof. Huanqing YE
University of Manchester
Venue: N23-4018
Time: 14:30 - 15:30
Hosted by: Prof. Handong SUN

Abstract

Molecular rare-earth materials uniquely combine the optical properties of rare-earth ions with the processibility of organic materials. This combination enables the development of cable and cost-effective integrated light source technologies. Rare-earth ions are particularly beneficial due to their long-lived optical and electronic states, ensuring the emitted light remains stable and predictable. In organic environments, there are significant drawbacks, primarily due to vibrational quenching effects, which couple nonradiative processes with rare-earth energy levels, reducing quantum efficiency and coherence properties. This talk will introduce our research on the correlation between organic vibrational modes, optical transitions and electronic states of rare-earth ions that emit technologically important telecom-compatible near-infrared wavelengths. Additionally, the talk will discuss the advantages of organic sensitisation in enhancing the power efficiency of rare-earth-based gain materials, previous R&D of developing integrated on-chip devices, and our recent studies regarding the potential applications of these materials in quantum optics.

Biography

Prof. Huanqing Ye is a Dame Kathleen Ollerenshaw Fellow and Assistant Professor at the Photon Science Institute and the Department of Electrical and Electronic Engineering at the University of Manchester since 2022. His current research interest focuses on the optical characterisation of nanophotonic materials and the development of active photonic integrated devices. He was the senior scientist at Chromosol Ltd, a spin-out company from Queen Mary University of London, from 2018 to 2022, leading the R&D of organic-integrated silicon lasers for photonics 2.0. He worked as a postdoctoral research fellow at Nanyang Technological University in Singapore from 2015 to 2018 and obtained a PhD in Physics at Queen Mary University of London in 2014. He authored over 30 research papers with an H-index of 16 and has participated in projects totalling £5M funding from Innovate UK and UK Research Innovation as co-investigators.

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