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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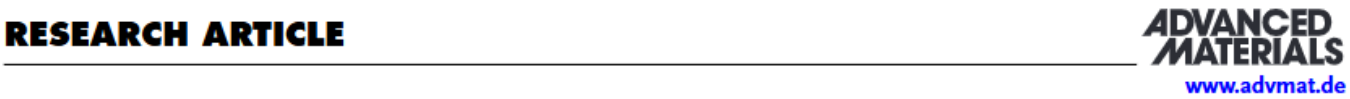
ISSUE 22

19 February 2025

✧ Content

❖ Publications (IF≥8, and/or Nature Index; *corresponding author)

1. **Rui Duan,** Qiang Zhang*, Yi Tian Thung, Xuehong Zhou, Tingting Yin, Yutian Ao, Lian Xiao, Zitong Zhang, Calvin Xiu Xian Lee, Tianhua Ren, Hilmi Volkan Demir, Wen Siang Lew, Baile Zhang*, and **Handong Sun*.** Continuous-Wave Pumped Self-Assembled Colloidal Topological Lasers. *Advanced Materials*, 2416635 (2025). DOI: 10.1002/adma.202416635. [2023 IF=27.4]


RESEARCH ARTICLE

ADVANCED MATERIALS
www.advmat.de

Continuous-Wave Pumped Self-Assembled Colloidal Topological Lasers

Rui Duan, Qiang Zhang, Yi Tian Thung, Xuehong Zhou, Tingting Yin, Yutian Ao, Lian Xiao, Zitong Zhang, Calvin Xiu Xian Lee, Tianhua Ren, Hilmi Volkan Demir, Wen Siang Lew, Baile Zhang,* and Handong Sun**

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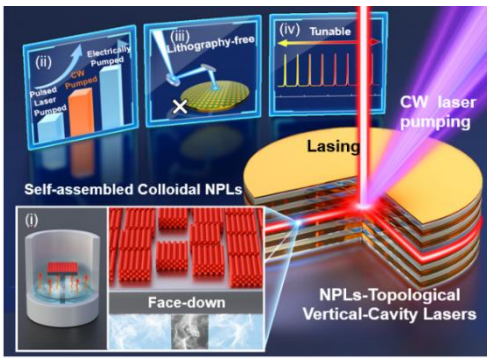
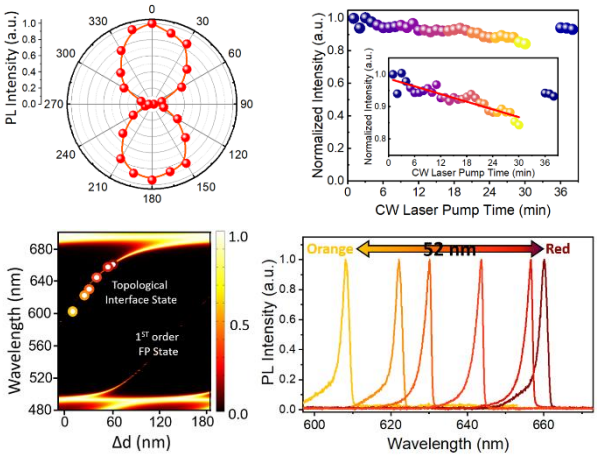
❖ Research Stories

UM research team developed continuous-wave pumped self-assembled colloidal topological lasers

- The field of optoelectronic integrated circuits is actively developing reliable and efficient room-temperature continuous-wave (CW) lasers. CW-pumped colloidal lasers combine the flexibility of colloidal semiconductor nanocrystals with the output stability of CW pumping, which will have a significant impact on the next generation of semiconductor lasers. However, development is still severely challenged by limitations such as gain materials and cavity structures. Consequently, as a compromise, most colloidal semiconductor lasers proposed to date have relied on another pulsed laser as the pumping source.
- For the first time, the team has developed a self-assembled colloidal topological laser that operates with CW pumping at room temperature. By utilizing an interfacial self-assembly strategy, the nanoplatelets (NPLs) are controlled to achieve collective orientation (face-down and edge-up), resulting in controlled polarization of amplified spontaneous emission.
- The team achieved precise control over the thickness of a single NPL layer, enabling the laser system to offer extensive wavelength tunability (over 50 nm), ultra-high polarization (over 95%), and good temporal stability. These metrics signify the optimal performance level of colloidal semiconductor lasers, marking a new era in solution processing systems for the optoelectronic integrated circuit field.

(From left) Dr. Rui Duan (段瑞) and Prof. Handong Sun (孫漢東)





Rui Duan, Qiang Zhang*, Yi Tian Thung, Xuehong Zhou, Tingting Yin, Yutian Ao, Lian Xiao, Zitong Zhang, Calvin Xiu Xian Lee, Tianhua Ren, Hilmi Volkan Demir, Wen Siang Lew, Baile Zhang*, and **Handong Sun***. Continuous-Wave Pumped Self-Assembled Colloidal Topological Lasers. *Advanced Materials*, 2416635 (2025). DOI: 10.1002/adma.202416635. [2023 IF=27.4]

Prof. Handong Sun, Prof. Baile Zhang and Dr. Qiang Zhang are the corresponding authors of this study. The first author is Dr. Rui Duan, who is a postdoctoral researcher at IAPME. This work was supported by CPG2024-00006, SRG2023-00025, and the Science and Technology Development Fund (FDCT), Macao SAR (File no. 0122/2023/RIA2). Prof. Baile Zhang acknowledges the Singapore National Research Foundation Competitive Research Program grant NRF-CRP23-2019-0007 and Singapore Ministry of Education Academic Research Fund Tier 1 grant RG139/22. Dr. Qiang Zhang acknowledges the support from National Natural Science Foundation of China No. 12104318.

❖ Visits

Prof. Yuxin Tang (湯育欣), from Fuzhou University, visited IAPME and gave speech on "Design of polymer electrolytes for all-solid-state lithium-ion batteries" recently in January 2025.

Prof. Yuxin Tang is a Professor and Doctoral Director of Fuzhou University, and a national young talent introduced from overseas. He is mainly engaged in basic and applied research on energy storage batteries and has achieved a series of innovative results in controllable preparation of electrode materials for energy storage, electrolyte design, and performance of energy storage devices and their optimization through continuous basic and applied research. Now, his main research interests are all-solid-state batteries and their solid-state electrolyte design, electrode materials and electrolyte design for special batteries, in-situ monitoring technology for real-time electrochemical reactions and battery safety assessment. So far, he has published more than 110 academic articles in professional journals (Sci. Adv., Adv. Mater., JACS, Angew. Chem., Chem. Soc. Rev., etc.) in the field of materials and chemical engineering.

❖ Visits

Invited by Prof. Shi Chen, Chair Prof. Xingzhu Wang (王行柱) from the University of South China, visited IAPME on January 24, 2025. Prof. Wang gave a talk on "Design and synthesis of functional molecular materials and their application in high-efficiency perovskite solar cells".

Prof. Xingzhu Wang obtained his Ph.D. degree from the Hong Kong Baptist University in 2009. After postdoctoral work at the University of Cambridge and Nanyang Technological University, he joined the National University of Singapore from 2013 to 2017 as a Senior Research Fellow. He joined SUSTech in 2018 as an Associate Professor and was named Full Professor in 2020.

Prof. Wang's current research interests relate to organic-inorganic synthesis, organic-inorganic semiconductors, and optoelectronic devices. He obtained 30 financial projects and had published 170 SCI scientific papers in high-quality and high-impact international journals including Science., Nat. Mater., Joule, J. Am. Chem. Soc., Angew. Chem., Adv. Mater., etc. The published papers had been cited by more than 5000 times. He has 30 authorized patents. He has won more than 6 national and provincial science and technology awards.

Prof. Wang also had fruitful discussions on the collaboration of perovskite researches with multiple professors in IAPME. His expertise on materials synthesis shows plausible research collaboration routes on perovskite studies. After the discussion, Prof. Wang also visited multiple labs in IAPME and had a campus tour.

❖ Upcoming Events

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IAPME Seminar

Current research on fine structure regulation of semiconductors towards artificial photosynthesis

25 February 2025

Prof. Qing GUO
Xi'an Jiaotong University
Venue: N23-4018
Time: 10:00 – 11:00
Hosted by: Prof. Hui PAN

Abstract:
Drawing on the principles and structures of natural photosynthesis, converting H_2O and CO_2 into high-value chemicals and solar fuels through the artificial photosynthesis is one of the ideal solutions to resolve the energy crisis and environmental issues. However, to achieve efficient and highly selective solar-to-chemical energy conversion, the key lies in the development of high-performance photocatalysts. Semiconductor materials, because of their excellent light absorption properties, unique quantum confinement characteristics, and simple synthesis methods, have attracted widespread attentions in the field of artificial photosynthesis. Nevertheless, current semiconductor-based artificial photosynthesis systems face challenges such as a lack of reactive sites and sluggish charge-carrier dynamics, which lead to low reaction efficiency and selectivity. To this end, we have achieved efficient and highly selective conversion of solar energy into chemical energy by finely regulating the material structure, introducing catalytic active sites, and promoting charge-carrier dynamics.

Biography:
Professor Qing GUO received her Bc. D in LanZhou University in 2014, and Ph.D. in Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, Republic of China, under the guidance of Academician Wu Li-Zhu in 2019. Currently, she is a Assistant Professor of the School of Chemistry at Xi'an Jiaotong University. She hosted and participated in several National Natural Science Foundation of China. Her achievements include the publication papers in scientific literature, including *Chem*, *Angew. Chem. Int. Ed.*, *ACS Catal.*, *J. Mater. Chem. A*, and so on. Her research interests are primarily in solar-light-driven redox reactions based on II-VA semiconductor nanocrystals and halide perovskite, including H_2 evolution, CO_2 reduction and organic synthesis.

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