

# Nanoscale Horizons

The home for rapid reports of exceptional significance in nanoscience and nanotechnology  
[rsc.li/nanoscale-horizons](https://rsc.li/nanoscale-horizons)

*The Royal Society of Chemistry is the world's leading chemistry community. Through our high impact journals and publications we connect the world with the chemical sciences and invest the profits back into the chemistry community.*

## IN THIS ISSUE

ISSN 2055-6756 CODEN NHAOAW 8(10) 1293–1442 (2023)



### Cover

See Jongwon Lee,  
Shinhyun Choi *et al.*,  
pp. 1366–1376.  
Image reproduced  
by permission of  
Shinhyun Choi and  
See-On Park from  
*Nanoscale Horiz.*,  
2023, **8**, 1366.



### Inside cover

See Svenja Morsbach *et al.*,  
pp. 1377–1385.  
Image reproduced  
by permission of  
Stefan Schuhmacher from  
*Nanoscale Horiz.*,  
2023, **8**, 1377.

## EDITORIAL

1300

**Nanoscale Horizons Emerging Investigator Series:**  
**Dr Ran Long, University of Science and Technology**  
**of China, China**

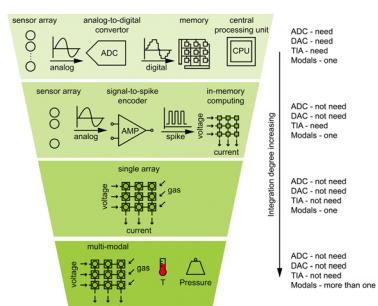


## REVIEWS

1301

**Four levels of in-sensor computing in bionic olfaction: from discrete components to multi-modal integrations**

Lin Liu, Yuchun Zhang and Yong Yan\*



**Editorial Staff****Executive Editor**

Michaela Mühlberg

**Managing Editor**

Heather Montgomery

**Editorial Production Manager**

Jonathon Watson

**Senior Publishing Editor**

Alex Metherell

**Development Editor**

Edward Gardner

**Publishing Editors**

Matthew Blow, Chris Dias, Rob Hinde, Ash Hyde, Evie Karkera, Tamara Kosikova, Carole Martin, Kirsty McRoberts, Cat Schofield, Ella White, Tom Williams

**Editorial Assistant**

Elizabeth So

**Assistant Editors**

Jie Gao, Yu Zhang

**Publisher**

Sam Keltie

For queries about submitted papers, please contact Jonathon Watson, Editorial Production Manager in the first instance.

E-mail: [nanoscalehorizons@rsc.org](mailto:nanoscalehorizons@rsc.org)

For pre-submission queries please contact

Michaela Mühlberg, Executive Editor.

E-mail: [nanoscalehorizons-rsc@rsc.org](mailto:nanoscalehorizons-rsc@rsc.org)

Nanoscale Horizons (print: ISSN 2055-6756 electronic: ISSN 2055-6764) is published 12 times a year by the Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, UK CB4 0WF. All orders, with cheques made payable to the Royal Society of Chemistry, should be sent to the Royal Society of Chemistry Order Department, Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, CB4 0WF, UK.

Tel +44 (0)1223 432398; E-mail [orders@rsc.org](mailto:orders@rsc.org)

2023 Annual (electronic) subscription price: £2727; \$4500. Customers in Canada will be subject to a surcharge to cover GST. Customers in the EU subscribing to the electronic version only will be charged VAT.

If you take an institutional subscription to any Royal Society of Chemistry journal you are entitled to free, site-wide web access to that journal. You can arrange access via Internet Protocol (IP) address at [www.rsc.org/ip](http://www.rsc.org/ip)

Customers should make payments by cheque in sterling payable on a UK clearing bank or in US dollars payable on a US clearing bank.

Whilst this material has been produced with all due care, the Royal Society of Chemistry cannot be held responsible or liable for its accuracy and completeness, nor for any consequences arising from any errors or the use of the information contained in this publication. The publication of advertisements does not constitute any endorsement by the Royal Society of Chemistry or Authors of any products advertised. The views and opinions advanced by contributors do not necessarily reflect those of the Royal Society of Chemistry which shall not be liable for any resulting loss or damage arising as a result of reliance upon this material. The Royal Society of Chemistry is a charity, registered in England and Wales, Number 207890, and a company incorporated in England by Royal Charter (Registered No. RC000524), registered office:

Burlington House, Piccadilly, London W1J 0BA, UK, Telephone: +44 (0) 207 4378 6556.

Advertisement sales:

Tel +44 (0) 1223 432246; Fax +44 (0) 1223 426017; E-mail [advertising@rsc.org](mailto:advertising@rsc.org)

For marketing opportunities relating to this journal, contact [marketing@rsc.org](mailto:marketing@rsc.org)

# Nanoscale Horizons

[rsc.li/nanoscale-horizons](http://rsc.li/nanoscale-horizons)

*Nanoscale Horizons* is the home for urgent short reports of exceptionally high quality & innovative nanoscience & nanotechnology



Published in collaboration with the National Centre for Nanoscience and Technology, Beijing, China

## Editorial Board

**Chair**

Katharina Landfester, Max Planck Institute for Polymer Research, Germany

**Scientific Editors**

Katsuhiko Ariga, National Institute for Materials Science (NIMS), Japan

Wenlong Cheng, Monash University, Australia

Miaofang Chi, Oak Ridge National Laboratory, USA

Yves Dufrêne, Université Catholique de

**Louvain, Belgium**

Anna Fontcuberta i Morral, École polytechnique fédérale de Lausanne, Switzerland

Dirk Guldi, Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

Jin-Hong Park, Pohang University of Science and Technology, South Korea

Zhiyong Tang, National Center for

Nanoscience and Technology, China

Jinlan Wang, Southeast University, China

**Members**

Michael Sailor, University of California, San Diego, USA

Sarah Tolbert, University of California, Los Angeles, USA

Miqin Zhang, University of Washington, USA

## Advisory Board

Chunli Bai, Chinese Academy of Sciences, China

Uri Banin, Hebrew University of Jerusalem, Israel

Frank Caruso, University of Melbourne, Australia

Cinzia Casiraghi, The University of

Manchester, UK

Paola Cerone, University of Bologna, Italy

Chunying Chen, National Center for

Nanoscience and Technology, China

Xiaodong Chen, Nanyang Technological

University, Singapore

Serena Cusser, University of Sheffield, UK

Harold Craighead, Cornell University, USA

Qing Dai, National Center for Nanoscience

and Technology, China

Shuai Dong, Southeast University, China

Laura Fabris, Rutgers University, USA

Andrea Ferrari, University of Cambridge, UK

Raju Kumar Gupta, Indian Institute of

Technology Kanpur, India

Xingyu Jiang, Southern University of

Science and Technology, China

Rongchao Jin, Carnegie Mellon University,

USA

Dong Ha Kim, Ewha Womans University,

South Korea

Jang-Kyo Kim, University of New South Wales, Australia

Kostas Kostarelos, University of Manchester,

Yamuna Krishnan, University of Chicago, USA

Tai Wei David Leong, National University of Singapore, Singapore

Quan Li, Chinese University of Hong Kong, Hong Kong

Xing Yi Ling, Nanyang Technological

University, Singapore

Jie Liu, Duke University, USA

Xiaogang Liu, National University of

Singapore, Singapore

Renzhi Ma, National Institute for Materials

Science, Japan

Stefan Maier, Ludwig-Maximilians-

Universität München, Germany

Liberato Manna, Istituto Italiano di

Tecnologia, Italy

Chad Mirkin, Northwestern University, USA

Paul Mulvaney, University of Melbourne, Australia

Catherine Murphy, University of Illinois at Urbana-Champaign, USA

Valeria Nicolosi, Trinity College Dublin, Ireland

Dong Qin, Georgia Institute of Technology, USA

Sandra Rosenthal, Vanderbilt University, USA

Paolo Samori, Université de Strasbourg, France

Ester Segal, Technion - Israel Institute of Technology, Israel

Elena Shevchenko, Argonne National Laboratory, USA

Hisanori Shinohara, Nagoya University, Japan

Zuzanna Siwy, University of California, Irvine, USA

Sara Skrabalak, Indiana University, USA

Francesco Stellacci, École polytechnique

fédérale de Lausanne, Switzerland

Ling-Dong Sun, Peking University, China

Shouheng Sun, Brown University, USA

Jonathan Veinot, University of Alberta, Canada

Umesh Waghmare, Jawaharlal Nehru Centre for Advanced Scientific Research, India

Jianfang Wang, Chinese University of Hong Kong, Hong Kong SAR

Sharon Weiss, Vanderbilt University, USA

Benjamin Wiley, Duke University, USA

Stefan Zauscher, Duke University, USA

Xiao Cheng Zeng, University of Nebraska-Lincoln, USA

Hongjie Zhang, Changchun Institute of Applied Chemistry, China

Hua Zhang, City University of Hong Kong, China

Manzhou Zhu, Anhui University, China

Jin Zou, University of Queensland, Australia

## Community Board

Serena Carrara, CNRS Aix-Marseille

Université, France

Arun Richard Chandrasekaran, The RNA

Institute, University at Albany, SUNY, USA

Ying Diao, University of Illinois at Urbana-

Champaign, USA

Qingchen Dong, Shanghai University, China

Yuanxian Fang, Fuzhou University, China

Azhar Fakharuddin, Interuniversity

Microelectronics Centre, Belgium

Calum T. J. Ferguson, Max Planck Institute

for Polymer Research, Germany

Lucas Güniat, EPFL, Switzerland

Marilena Hadjimetiou, University of

Manchester, UK

Shumeng Hao, Georgia Institute of

Technology, USA

Samuel S. Hinman, Berkeley Lights, Inc, USA

Nobuhiko Hosono, University of Tokyo, Japan

Jundie Hu, Suzhou University of Science and

Technology, China

Shuaidong Huo, Xiamen University, China

Ignacio Insua, University of Santiago de

Compostela, Spain

Debrina Jana, Indian Institute of Science

Education and Research Mohali, India

Nathaniel Richey, Stanford University, USA

Ruibin Jiang, Shaanxi Normal University, China

Yih Hong Lee, Nanyang Technological

University, Singapore

Sarah Lerch, Chalmers University of

Technology, Sweden

Li Li, Northeastern University, USA

Zhiyuan Liu, Shenzhen Institute of Advanced

Technology, Chinese Academy of Sciences,

China

Saeed Nazemidashrjani, The University of

Texas at Austin, USA

Sabina Alexandra Nicolae, Queen Mary

University of London/Imperial College

London, UK

Anamaria Orza, Emory University, USA

Pepita Pla-Vilanova, University of Lleida,

Spain

Amirali Popat, The University of Queensland,

Australia

Kalyan Raidongia, Indian Institute of

Technology Guwahati, India

Satyajit Rath, Indian Institute of Technology

Bhubaneswar, India

Nathaniel Richey, Stanford University, USA

Jungki Ryu, Ulsan National Institute of

Science and Technology, Korea

Lei Shao, Beijing Computational Science

Research Center, China

Pengzhan Sun, University of Manchester, UK

Jing Tang, The University of Queensland,

Australia

Yanlong Wang, Dalian Institute of Chemical

Physics, China

Jiangjixing Wu, Tianjin University, China

Tong Wu, Qingdao University, China

Wenzhuo Wu, Purdue University, USA

Xiuqiang Xie, Hunan University, China

Liguang Xu, Jiangnan University, China

Yikai Xu, Queen's University Belfast, UK

Nobuhiko Yanai, Kyushu University, Japan

Fei Zhang, Tianjin University, China

Zishuai Zhang, The University of British

Columbia, Canada

Ya Zhou, Advanced Micro-Fabrication

Equipment Inc., China

Kai Zhu, Harbin Engineering University,

China

Xiaolu Zhuo, CICBiomagnate, Spain

## Information for Authors

Full details on how to submit material for publication in *Nanoscale Horizons* are given in the Instructions for Authors (available from <http://www.rsc.org/authors>). Submissions should be made via the journal's homepage: [rsc.li/nanoscale-horizons](http://rsc.li/nanoscale-horizons)

Authors may reproduce/republish portions of their published contribution without seeking permission from the Royal Society of Chemistry, provided that any such republication is accompanied by an acknowledgement in the form: (Original Citation)–Reproduced by permission of the Royal Society of Chemistry.

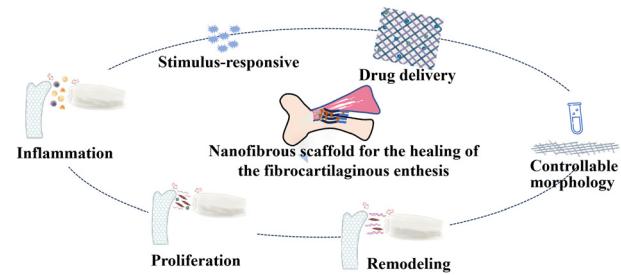
This journal is © The Royal Society of Chemistry 2023. Apart from fair dealing for the purposes of research or private study for non-commercial purposes, or criticism or review, as permitted under the Copyright, Designs and Patents Act 1988 and the Copyright and Related Rights Regulation 2003, this publication may only be reproduced, stored or transmitted, in any form or by any means, with the prior permission in writing of the Publishers or by the case of reprographic reproduction in accordance with the terms of licences issued by the Copyright Licensing Agency in the UK. US copyright law is applicable to users in the USA. Registered charity number: 207890

## REVIEWS

1313

**Nanofibrous scaffolds for the healing of the fibrocartilaginous enthesis: advances and prospects**

Xin Li, Yan Ren, Yueguang Xue, Yiming Zhang and Ying Liu\*

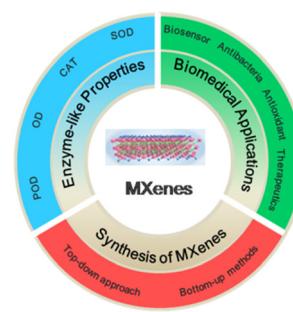


## MINIREVIEWS

1333

**MXene-based nanomaterials with enzyme-like properties for biomedical applications**

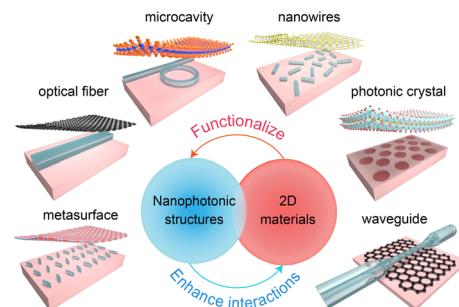
Rong Yang,\* Shiqi Wen, Shuangfei Cai,\* Wei Zhang,\* Ting Wu and Youlin Xiong



1345

**Functionalizing nanophotonic structures with 2D van der Waals materials**

Yuan Meng, Hongkun Zhong, Zhihao Xu, Tiantian He, Justin S. Kim, Sangmoon Han, Sunok Kim, Seoungwoong Park, Yijie Shen, Mali Gong, Qirong Xiao\* and Sang-Hoon Bae\*

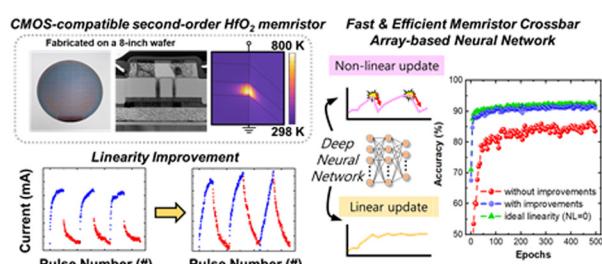


## COMMUNICATIONS

1366

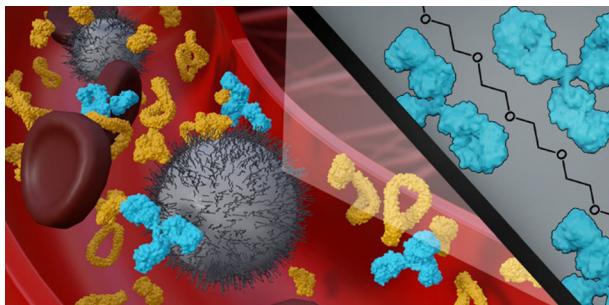
**Linear conductance update improvement of CMOS-compatible second-order memristors for fast and energy-efficient training of a neural network using a memristor crossbar array**

See-On Park, Taehoon Park, Hakcheon Jeong, Seokman Hong, Seokho Seo, Yunah Kwon, Jongwon Lee\* and Shinyun Choi\*



## COMMUNICATIONS

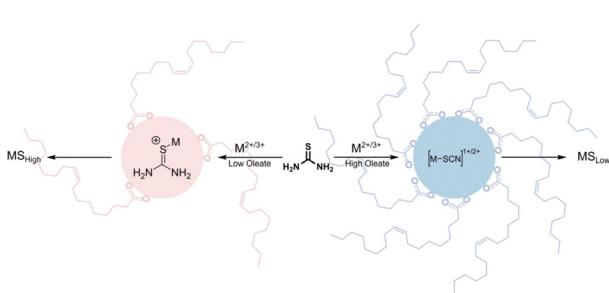
1377



### Anti-PEG antibodies enriched in the protein corona of PEGylated nanocarriers impact the cell uptake

Mareike F. S. Deuker, Volker Mailänder, Svenja Morsbach\* and Katharina Landfester

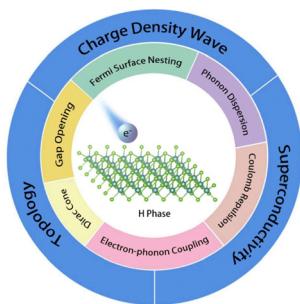
1386



### Role of carboxylates in the phase determination of metal sulfide nanoparticles

Andrey A. Shults, Guanyu Lu, Joshua D. Caldwell and Janet E. Macdonald\*

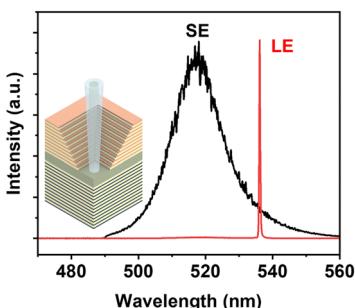
1395



### Interplay of the charge density wave transition with topological and superconducting properties

Zishen Wang, Jing-Yang You, Chuan Chen, Jinchao Mo, Jingyu He, Lishu Zhang, Jun Zhou,\* Kian Ping Loh\* and Yuan Ping Feng\*

1403



### Stable continuous-wave lasing from discrete cesium lead bromide quantum dots embedded in a microcavity

Hongbo Zhang, Wen Wen, Bowen Du, Lei Zhou, Yu Chen, Shun Feng, Chenji Zou, Lishu Wu, Hong Jin Fan, Weibo Gao, Handong Sun,\* Jingzhi Shang\* and Ting Yu\*



## COMMUNICATIONS

1411

**Phosphinecarboxamide based InZnP QDs – an air tolerant route to luminescent III–V semiconductors**

Yi Wang, Jack Howley, Erica N. Faria, Chen Huang, Sadie Carter-Searjeant, Simon Fairclough, Angus Kirkland, Jason J. Davis, Falak Naz, Muhammad Tariq Sajjad, Jose M. Goicoechea\* and Mark Green\*

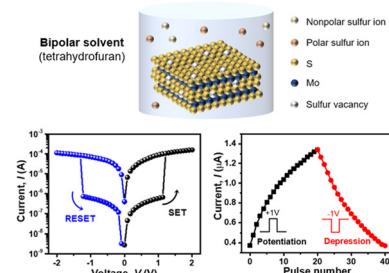


1417

**Solvent-assisted sulfur vacancy engineering method in MoS<sub>2</sub> for a neuromorphic synaptic memristor**

Jiyeon Kim, Changik Im, Chan Lee, Jinwoo Hwang, Hyoik Jang, Jae Hak Lee, Minho Jin, Haeyeon Lee, Junyoung Kim, Junho Sung, Youn Sang Kim\* and Eunho Lee\*

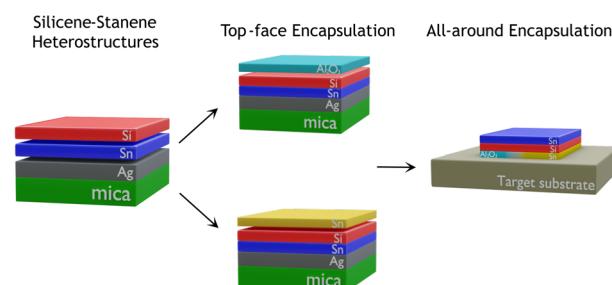
## Solvent-Assisted Vacancy Engineering (SAVE)



1428

**All-around encapsulation of silicene**

Daya S. Dhungana, Chiara Massetti, Christian Martella\*, Carlo Grazianetti\* and Alessandro Molle\*



1435

**Atomically precise Au<sub>x</sub>Ag<sub>25-x</sub> nanoclusters with a modulated interstitial Au–Ag microenvironment for enhanced visible-light-driven photocatalytic hydrogen evolution**

Ye Liu, Zhi Li, Xiao-He Liu, Nicola Pinna\* and Yu Wang\*

