

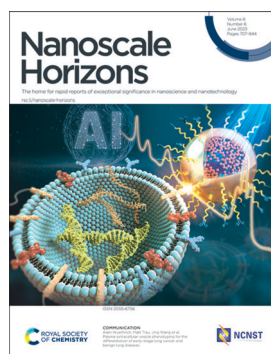
# Nanoscale Horizons

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(6) 707-844 (2023)



### Cover

See Alain Wuethrich, Matt Trau, Jing Wang *et al.*, pp. 746–758. Image reproduced by permission of Jing Wang from *Nanoscale Horiz.*, 2023, 8, 746.



### Inside cover

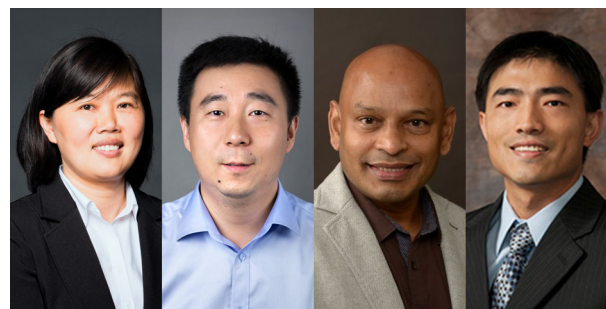
See Muhammad Zubair, Muhammad Qasim Mehmood, Yehia Massoud, Junsuk Rho *et al.*, pp. 759–766. Image reproduced by permission of Prof. Dr Yehia Massoud from *Nanoscale Horiz.*, 2023, 8, 759.

## EDITORIAL

714

### Introduction to new horizons in materials for energy conversion, optics and electronics

Jinlan Wang,\* Yuanjian Zhang,\* Seeram Ramakrishna\* and Guihua Yu\*

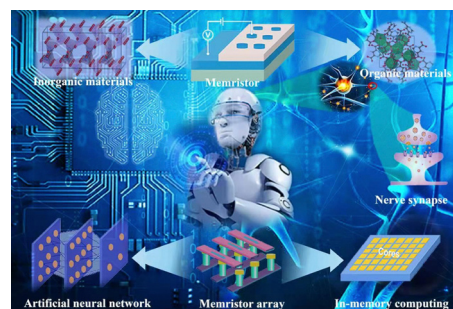


## REVIEW

716

### Memristor-based neural networks: a bridge from device to artificial intelligence

Zelin Cao, Bai Sun,\* Guangdong Zhou, Shuangso Mao, Shouhui Zhu, Jie Zhang, Chuan Ke, Yong Zhao and Jinyou Shao\*



## 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.org](mailto:nanoscalehorizons@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 Dufrene, 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 Ceroni, University of Bologna, Italy

Chunying Chen, National Center for Nanoscience and Technology, China

Xiaodong Chen, Nanyang Technological University, Singapore

Serena Cussen, 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,

### UK

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

Paola Rosenthal, Vanderbilt University, USA

Sandro 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 Veintou, 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

Yuanxing Fang, Fuzhou University, China

Azhar Fakharuddin, Interuniversity Microelectronics Centre, Belgium

Calum T. J. Ferguson, Max Planck Institute for Polymer Research, Germany

Lucas Günati, EPFL, Switzerland

Marilena Hadjidemetriou, 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

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 Nazemidashtarjandi, 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 Papat, The University of Queensland, Australia

Kalyan Raidongia, Indian Institute of Technology Guwahati, India

Satyajit Ratha, 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

Jiangxiang 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

Nobuhiro 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, CICbiomagnum, 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 in 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.

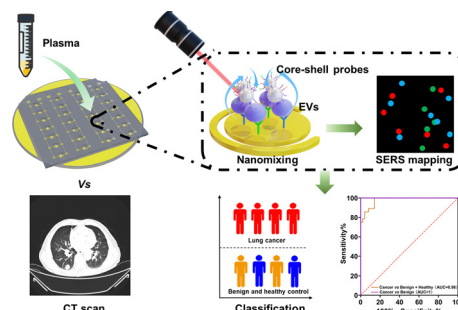
Registered charity number: 207890



746

### Plasma extracellular vesicle phenotyping for the differentiation of early-stage lung cancer and benign lung diseases

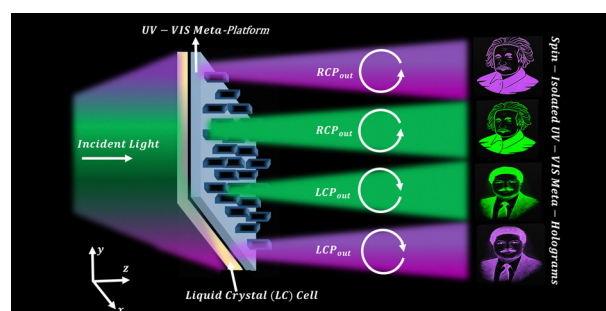
Liwen Yuan, Yanpin Chen, Longfeng Ke, Quan Zhou, Jiayou Chen, Min Fan, Alain Wuethrich,\* Matt Trau\* and Jing Wang\*



759

### Spin-isolated ultraviolet-visible dynamic meta-holographic displays with liquid crystal modulators

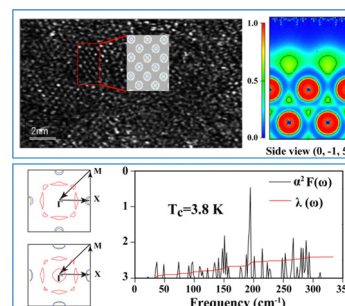
Aqsa Asad, Joohoon Kim, Hafiz Saad Khaliq, Nasir Mahmood, Jehan Akbar, Muhammad Tariq Saeed Chani, Yeseul Kim, Dongmin Jeon, Muhammad Zubair,\* Muhammad Qasim Mehmood,\* Yehia Massoud\* and Junsuk Rho\*



767

### A novel two-dimensional superconducting Ti layer: density functional theory and electron-beam irradiation

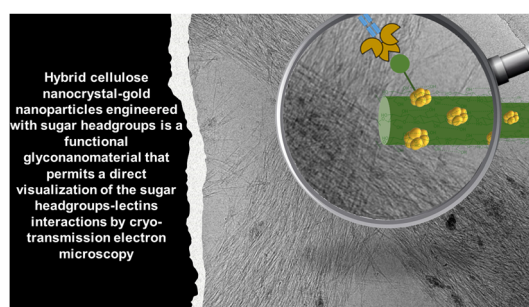
Xiao-Min Zhang, Jiawei Tang, Jing Zhang, Jin Yu, Litao Sun, Zhiqing Yang,\* Ke Xia\* and Weiwei Sun\*



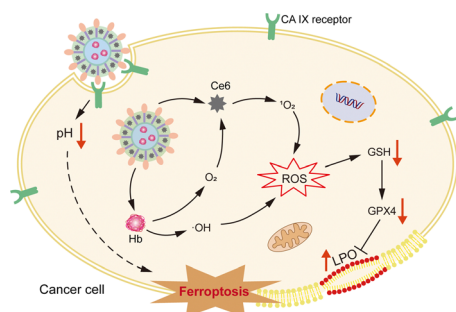
776

### Simple engineering of hybrid cellulose nanocrystal-gold nanoparticles results in a functional glyconanomaterial with biomolecular recognition properties

Giacomo Biagiotti, Gianluca Toniolo, Martin Albino, Mirko Severi, Patrizia Andrezzi, Marcello Marelli, Hana Kokot, Giancarlo Tria, Annalisa Guerri, Claudio Sangregorio, Javier Rojo, Debora Berti, Marco Marradi, Stefano Cicchi, Iztok Urbančič, Yvette van Kooyk, Fabrizio Chiodo\* and Barbara Richichi\*



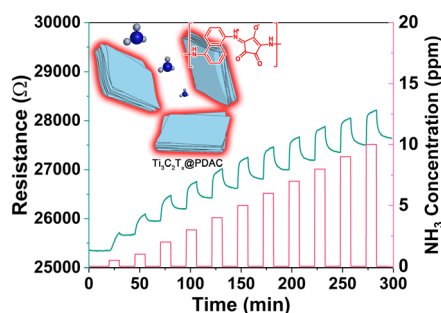
783



### Carbonic anhydrase IX-targeted nanovesicles potentiated ferroptosis by remodeling the intracellular environment for synergetic cancer therapy

Nian Liu, Qian Lin, Wenbao Zuo, Weibin Chen, Shan Huang, Yinshu Han, Xing-Jie Liang,\* Xuan Zhu\* and Shuidong Huo\*

794

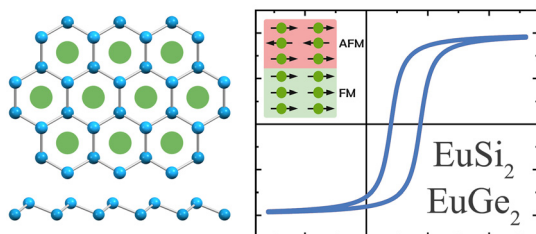


### An ultra-sensitive NH<sub>3</sub> gas sensor enabled by an ion-in-conjugated polycroconaine/Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> core-shell composite

Jin Zhou, Seyed Hossein Hosseini Shokouh, Linfan Cui, Topias Järvinen, Olli Pitkänen, Zhong-Peng Lv\* and Krisztian Kordas\*

803

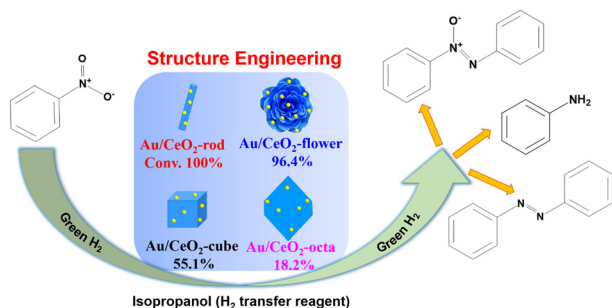
### exchange bias state



### Intrinsic exchange bias state in silicene and germanene materials EuX<sub>2</sub>

Dmitry V. Averyanov, Ivan S. Sokolov, Alexander N. Taldenkov, Oleg E. Parfenov, Igor A. Karateev, Oleg A. Kondratev, Andrey M. Tokmachev and Vyacheslav G. Storchak\*

812



### Structure engineering of CeO<sub>2</sub> for boosting the Au/CeO<sub>2</sub> nanocatalyst in the green and selective hydrogenation of nitrobenzene

Junqing Ye, Meizan Jing, Yu Liang, Wenjin Li, Wanting Zhao, Jianying Huang, Yuekun Lai,\* Weiyu Song, Jian Liu and Jian Sun\*



827

## A light-operated integrated DNA walker–origami system beyond bridge burning

Xiao Rui Liu, long Ying Loh, Winna Siti, Hon Lin Too, Tommy Anderson and Zhisong Wang\*

