Materials Horizons

rsc.li/materials-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 2051-6347 CODEN MHAOAL 10(4) 1045-1456 (2023)



Cover

See Peng Xiao, Tao Chen et al., pp. 1264-1273. Image reproduced by permission of Peng Xiao from Mater. Horiz., 2023, 10, 1264.

EDITORIALS

1056

Materials Horizons Emerging Investigator Series: Dr Yue (Jessica) Wang, University of California, Merced, USA



1058

Materials Horizons Emerging Investigator Series: Dr Dominik Kubicki, University of Warwick, UK



Editorial Staff

Executive Editor

Michaela Mühlberg

Deputy Editor

Geraldine Hay

Editorial Production Manager Ionathon Watson

Senior Publishing Editor

Alex Metherell

Development Editor

Publishing Editors

Blake Baker, Matthew Blow, Robin Brabham, Chris Dias, Ash Hyde, Evie Karkera, Tamara Kosikova, Carole Martin, Kirsty McRoberts, Cat Schofield, Ella White, Tom Williams

Editorial Assistant

Daniel Smith

Publisher

Sam Keltie

For queries about submitted papers, please contact Jonathon Watson, Editorial Production Manager in the first instance. E-mail: materialshorizons@rsc.org

For pre-submission queries please contact Michaela Mühlberg, Executive Editor. E-mail: materialshorizons-rsc@rsc.org

Materials Horizons (electronic:

ISSN 2051-6355) 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

2023 Annual (electronic) subscription price: £2697, \$4615. 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

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

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

For marketing opportunities relating to this journal,

Materials Horizons

rsc.li/materials-horizons

Building and designing systems from the molecular level

Editorial Board

Martina Stenzel, University of New South Wales, Australia

Scientific Editors

Jean-Luc Bredas, University of Arizona, USA Bruno Chaudret, INSA, France

Guoping Chen, National Institute for Materials Science, Japan Yong Cui, Shanghai Jiao Tong University,

Zhongyi Jiang, Tianjin University, China Kisuk Kang, Seoul National University, South Korea Norbert Koch, Humboldt University of

Berlin, Germany Róisín Owens, University of Cambridge,

United Kingdom

Yi Long, Chinese University of Hong Kong, Hong Kong SAR, China

Members

Mark E. Thompson, University of Southern Shu Yang, University of Pennsylvania, USA

Advisory Board

Markus Antonietti, Max Planck Intitute of Colloids & Interfaces, Germany David Beljonne, University of Mons, Belgium Chris Bettinger, Carnegie Mellon University, USA

Kanishika Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research, India Paul Blom, Max Planck Institute for Polymer Research, Mainz, Germany Mischa Bonn, Max Planck Institute for Polymer Research, Germany Markus Buehler, Massachusetts Institute of

Technology, USA Jillian Buriak, University of Alberta, Canada Moyuan Cao, Nankai University, China

Yong Cao, South China University of Technology, China Rachel Caruso, University of Melbourne, Austrailia

Anthony Cheetham, University of Cambridge,

Hong Chen, Soochow University, China Brandi Cossairt, University of Washington,

Dibyendu Das, IISER Kolkata, India Luisa De Cola, University of Strasbourg, France Ulrike Diebold, Vienna University of

Technology, Austria Mircea Dinca, Massachusetts Institute of Technology, USA

Gitti Frey, Technion - Israel Institute of

Technology, Israel Richard Friend, University of Cambridge, UK Subi George, Jawaharlal Nehru Centre for Advanced Scientific Research, India Jian Ping Gong, Hokkaido University, Japan Grace Gu, University of California, Berkeley,

David Haddleton, University of Warwick, UK Martin Heeney, King Abdullah University of Science and Technology (KAUST), Saudi

Laura Herz, Univeristy of Oxford, UK Jurriaan Huskens, University of Twente,

Netherlands Hiroshi Imahori, Kyoto University, Japan Lei Jiang, Beihang University, China Antoine Kahn, Princeton University, USA Richard Kaner, University of California, Los

Angeles, USA Susumu Kitagawa, Kyoto University, Japan Anna Koehler, University of Bayreuth,

Frederik Krebs, Elite Science, Denmark Katharina Landfester, Max Planck Institute for Polymer Research, Germany Guglielmo Lanzani, İtalian Institute of Technology, Italy
Neng Li, Wuhan University of Technology,

Yan Li, Peking University, China Darren Lipomi, University of California, San Diego, USA Bin Liu, National University of Singapore,

Singapore Maria Antonietta Loi, University of

Groningen, Netherlands Lynn Yueh Lin Loo, Princeton University, USA Bettina Lotsch , Max Planck Institute for Solid State Research, Germany HongYee Low, Singapore University of Technology and Design, Singapore

Uttam Manna, Indian Institute of Technology-Guwahati, India Seth Marder, Georgia Institute of Technology,

Richard Martel, University of Montreal,

Hedi Mattoussi, Florida State University, USA David Mecerreyes, University of the Basque Country, Spain
Phillip Messersmith, University of California,

Berkeley, USA Catherine Murphy, University of Illinois

Urbana-Champaign, USA
K S Narayan, Jawaharlal Nehru Centre for
Advanced Scientific Research, India
Thuc-Quyen Nguyen, University of California, Santa Barbara, USA Markus Niederberger, ETH Zürich, Switzerland

Teri Odom, Northwestern University, USA Wee-Jun Ong, Xiamen University, Malaysia Moon Jeong Park, Pohang University of Science and Technoloy (POSTECH), Korea Marie-Paule Pileni, Pierre and Marie Curie University, France

Fundamental Research (TIFR), India C N R Rao, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore,

Erin Ratcliff, University of Arizona, USA Vince Rotello, University of Massachusetts at Amherst, USA David Scanlon, University College London,

Vivek Polshettiwar, Tata Institute of

United Kingdom Christine Schmidt, University of Florida, USA

Gregory D. Scholes, Princeton University, USA Rachel Segalman, University of California Santa Barbara, USA Peter Skabara, University of Glasgow, UK

Henry Snaith, University of Oxford, UK Takao Someya, University of Tokyo, Japan Kazuo Takimaya, RIKEN, Japan Luisa Torsi, University of Bari, Italy Ramanathan Vaidhyanathan, IISER Pune,

Aleks Vojvodic, University of Pennsylvania,

Eva Malmström Jonsson, KTH Royal Institute Elizabeth von Hauff, VU Amsterdam, The of Technology, Sweden Netherlands

Aron Walsh, Imperial College London, UK Shu Wang, Institute of Chemistry, Chinese Academy of Sciences, China Xun Wang, Tsinghua University, China Tanja Weil, Max Planck Institute for Polymer

Research, Germany Emily Weiss, Northwestern University, USA David Weitz, Harvard University, USA

Chris Wolverton, Northwestern University,

Yi Xie, University of Science and Technology of China, China Vivian Wing-Wah Yam, University of Hong Kong, Hong Kong Shannon Yee, Georgia Institute of Technology, USA

Jihong Yu, Jilin University, China Shu-Hong Yu, University of Science and Technology of China, China Aldo J. G. Zarbin, Universidade Federal do

Paraná, Brazil Xiaowei Zhan, Peking University, China Dongyuan Zhao, Fudan University, China

Community Board

Please see the Materials Horizons journal webpage for full details of our Community Board: rsc.li/materials-horizons

Information for Authors

Full details on how to submit material for publication in Materials 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/materials-horizons. Submissions: The journal welcomes submissions of manuscripts for publication as Communications, Reviews, Mini-reviews and Focus Articles. Communications should contain exceptionally significant scientific work of such importance that rapid publication is desirable. The research presented should provide new insight into the topic and be accessible to the broad readership of the journal.

Colour figures are reproduced free of charge. Additional details are available from the Editorial Office or http://www.rsc.org/authors 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

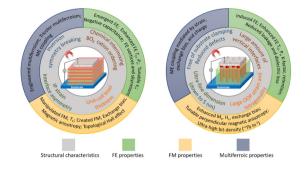


REVIEWS

1060

Interface-related phenomena in epitaxial complex oxide ferroics across different thin film platforms: opportunities and challenges

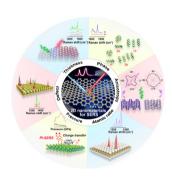
Judith L. MacManus-Driscoll,* Rui Wu* and Weiwei Li*



1087

Spotting the driving forces for SERS of two-dimensional nanomaterials

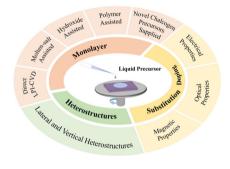
Jing Jin, Zhinan Guo,* Dianyuan Fan and Bing Zhao*



1105

Liquid-precursor-intermediated synthesis of atomically thin transition metal dichalcogenides

Huiyan Guan, Bei Zhao,* Weiwei Zhao and Zhenhua Ni*



1121

Extraordinary microcarriers derived from spores and pollens

Danshan Zhao, Yawen Li, Zhidong Zhang, Tian Xu, Chao Ye,* Tianqiong Shi* and Yuetong Wang*



REVIEWS

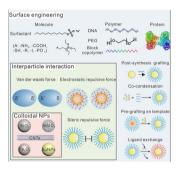
1140



The fundamentals and applications of piezoelectric materials for tumor therapy: recent advances and outlook

Yan Wang, Pengyu Zang, Dan Yang,* Rui Zhang, Shili Gai and Piaoping Yang*

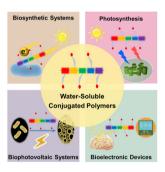
1185



Surface engineering of colloidal nanoparticles

Xinxin Jing, Yueyue Zhang, Min Li, Xiaolei Zuo, Chunhai Fan* and Junhua Zheng*

1210



Water-soluble conjugated polymers for bioelectronic systems

Zenghao Wang, Hongrui Lin, Miaomiao Zhang, Wen Yu, Chuanwei Zhu, Pengcheng Wang, Yiming Huang, Fengting Lv, Haotian Bai* and Shu Wang*

MINIREVIEW

1234



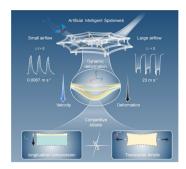
Noble metal nanodendrites: growth mechanisms, synthesis strategies and applications

Ke Guo, Dongdong Xu,* Lin Xu,* Yafei Li and Yawen Tang

1264

Dynamic competitive strains enabled self-supporting Janus nanostructured films for high-performance airflow perception

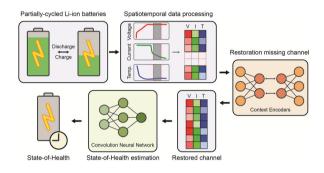
Wei Zhou, Peng Xiao,* Chang Zhang, Qing Yang and Tao Chen*



1274

Deep-learning based spatio-temporal generative model on assessing state-of-health for Li-ion batteries with partially-cycled profiles

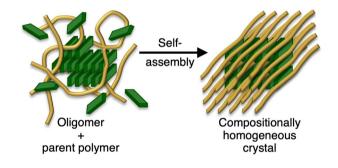
Seojoung Park, Hyunjun Lee, Zoe K. Scott-Nevros, Dongjun Lim, Dong-Hwa Seo, Yunseok Choi,* Hankwon Lim* and Donghyuk Kim*



1282

Oligoaniline-assisted self-assembly of polyaniline crystals

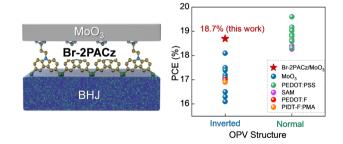
Ian M. Hill, Di Wu, Bohao Xu and Yue Wang*



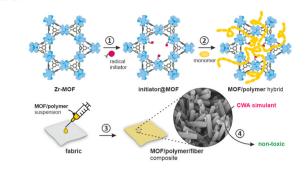
1292

18.73% efficient and stable inverted organic photovoltaics featuring a hybrid hole-extraction layer

Yuanbao Lin,* Yadong Zhang, Artiom Magomedov, Eleftheria Gkogkosi, Junxiang Zhang, Xiaopeng Zheng, Abdulrahman El-Labban, Stephen Barlow, Vytautas Getautis, Ergang Wang, Leonidas Tsetseris, Seth R Marder, Iain McCulloch and Thomas D. Anthopoulos*



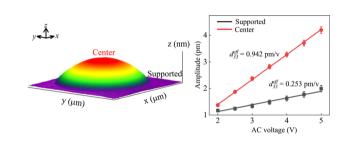
1301



MOF/polymer hybrids through in situ free radical polymerization in metal-organic frameworks

Marzena Pander, Rodrigo Gil-San-Millan, Pedro Delgado, Cristina Perona-Bermejo, Urszula Kostrzewa, Karol Kaczkowski, Dominik J. Kubicki,* Jorge A. R. Navarro* and Wojciech Bury*

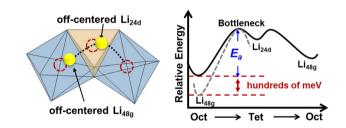
1309



Directly measuring flexoelectric coefficients μ_{11} of the van der Waals materials

Menghan Deng, Xiang Wang, Xionghu Xu, Anyang Cui,* Kai Jiang, Jinzhong Zhang, Liangqing Zhu, Liyan Shang, Yawei Li, Zhigao Hu* and Junhao Chu

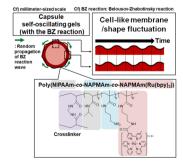
1324



Non-equilibrium kinetics for improving ionic conductivity in garnet solid electrolyte

Youwei Wang, Tiantian Wang, Xiaolin Zhao and Jianjun Liu*

1332



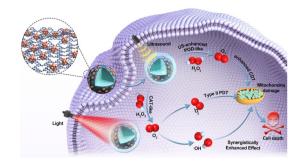
Capsule self-oscillating gels showing cell-like nonthermal membrane/shape fluctuations

Won Seok Lee, Takafumi Enomoto, Aya Mizutani Akimoto and Ryo Yoshida*

1342

The direct catalytic synthesis of ultrasmall Cu₂O-coordinated carbon nitrides on ceria for multimodal antitumor therapy

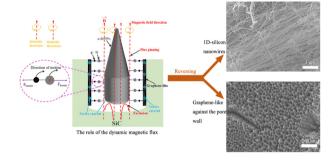
Lijian Cao, Ziyan Feng, Ruiqian Guo, Qinyu Tian, Weiwen Wang, Xiao Rong, Mi Zhou, Chong Cheng,* Tian Ma* and Dawei Deng*



1354

Reversing silicon carbide into 1D silicon nanowires and graphene-like structures using a dynamic magnetic flux template

Wenting Zhou, Qiang Liu and Qingsong Huang*



1363

Developing extended visible light responsive polymeric carbon nitrides for photocatalytic and photoelectrocatalytic applications

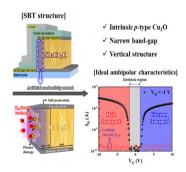
Sanjit Mondal, Gabriel Mark, Liel Abisdris, Junyi Li, Tirza Shmila, Jonathan Tzadikov, Michael Volokh, Lidan Xing and Menny Shalom*



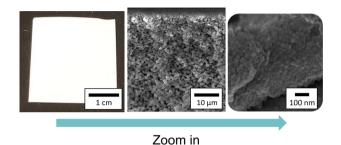
1373

Ambipolar operation of progressively designed symmetric bidirectional transistors fabricated using single-channel vertical transistor and electrochemically prepared copper oxide

Sung Hyeon Jung, Ji Sook Yang and Hyung Koun Cho*



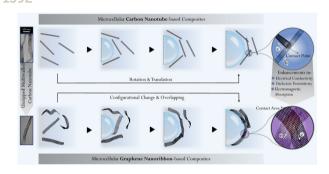
1385



Bicontinuous interfacially jammed emulsion gels with nearly uniform sub-micrometer domains via regulated co-solvent removal

Tiancheng Wang, Robert A. Riggleman, Daeyeon Lee* and Kathleen J. Stebe*

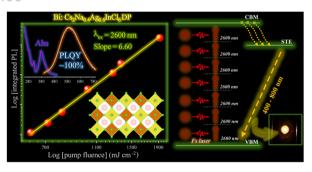
1392



Enhanced electrical properties of microcellular polymer nanocomposites via nanocarbon geometrical alteration: a comparison of graphene nanoribbons and their parent multiwalled carbon nanotubes

Meysam Salari, Saeed Habibpour, Mahdi Hamidinejad,* Sara Mohseni Taromsari, Hani E. Naguib, Aiping Yu and Chul B. Park*

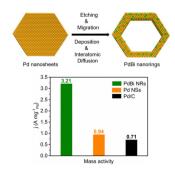
1406



Seven-photon absorption from Na⁺/Bi³⁺-alloyed Cs₂AgInCl₆ perovskites

Shiling Jin, Renfu Li, Jiwen Zhu, Tao Pang, Tianmin Wu,* Hongbing Zhan, Yuanhui Zheng, Feng Huang, Xueyuan Chen* and Daqin Chen*

1416



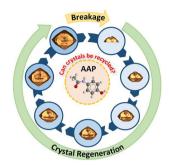
A universal synthesis of ultrathin Pd-based nanorings for efficient ethanol electrooxidation

Yu Wang, Mengfan Li, Zhilong Yang, Wenchuan Lai, Jingjie Ge, Minhua Shao, Yu Xiang,* Xuli Chen* and Hongwen Huang*

1425

Crystal regeneration – a unique growth phenomenon observed in organic crystals post breakage

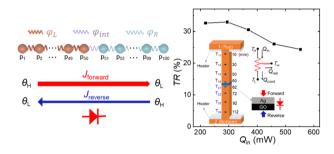
Isha Bade, Vivek Verma, Ian Rosbottom and Jerry Y. Y. Heng*



1431

Solid-state thermal rectification of bilayers by asymmetric elastic modulus

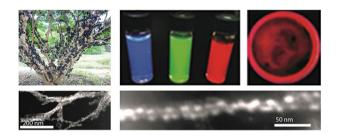
Junbyeong Lee, Seokjae Cha, Byung Ho Lee, Agha Aamir Jan, Rijin Kizhakkekara, Jaehun Yang, Moon Ki Kim* and Seunghyun Baik*



1440

Full-colour Jabuticaba-like nanostructures via the multiplex and orthogonal self-assembly of protein-conjugated quantum dots with engineered biofilms

Zhengtao Deng,* Allen Y. Chen, Bijan Zakeri, Chao Zhong and Timothy K. Lu*



1446

From optical pumping to electrical pumping: the threshold overestimation in metal halide perovskites

Jiajun Qin, Yang Tang, Jia Zhang, Tangyao Shen, Max Karlsson, Tiankai Zhang, Weidong Cai, Lei Shi,* Wei-Xin Ni and Feng Gao*

