

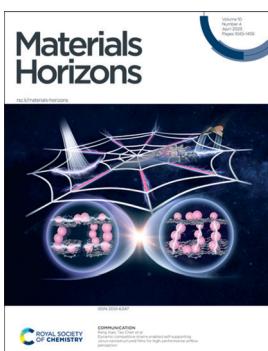
Materials Horizons

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)



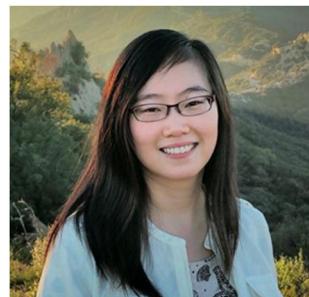
Cover

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

Jonathon Watson

Senior Publishing Editor

Alex Metherell

Development Editor

Rose Wedgbury

Publishing Editors

Blake Baker, Matthew Blow, Robin Brabham, Chris Dias, Ash Hyde, Evin 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 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 or 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,
contact marketing@rsc.org

Materials Horizons

rsc.li/materials-horizons

Building and designing systems from the molecular level

Editorial Board

Chair

Martina Stenzel, University of New South Wales, Australia

Guoping Chen, National Institute for Materials Science, Japan

Yong Cui, Shanghai Jiao Tong University, China

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 Institute of Colloids & Interfaces, Germany

Angeles, USA

David Beljonne, University of Mons, Belgium

Susumu Kitagawa, Kyoto University, Japan

Chris Bettinger, Carnegie Mellon University, USA

Anna Koehler, University of Bayreuth, Germany

Kanishka Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research, India

Frederik Krebs, Elite Science, Denmark

Paul Blom, Max Planck Institute for Polymer Research, Mainz, Germany

Katharina Landfester, Max Planck Institute for Polymer Research, Germany

Mischa Bonn, Max Planck Institute for Polymer Research, Germany

Guglielmo Lanzani, Italian Institute of Technology, Italy

Markus Buehler, Massachusetts Institute of Technology, USA

Neng Li, Wuhan University of Technology, China

Jillian Buriak, University of Alberta, Canada

Yan Li, Peking University, China

Moyan Cao, Nankai University, China

Darren Lipomi, University of California, San

Yong Cao, South China University of Technology, China

Diego, USA

Rachel Caruso, University of Melbourne, Australia

Bin Liu, National University of Singapore, Singapore

Anthony Cheetham, University of Cambridge, UK

Maria Antonietta Loi, University of Groningen, Netherlands

Hong Chen, Soochow University, China

Lynn Yueh Lin Foo, Princeton University, USA

Brandi Cossairt, University of Washington, USA

Bettina Lotsch, Max Planck Institute for Solid State Research, Germany

Dibyendu Das, IISER Kolkata, India

HongYee Low, Singapore University of Technology and Design, Singapore

Luisa De Cola, University of Strasbourg, France

Eva Malmström Jonsson, KTH Royal Institute of Technology, Sweden

Ulrike Diebold, Vienna University of Technology, Austria

Uttam Manna, Indian Institute of Technology-Guwahati, India

Mircea Dincă, Massachusetts Institute of Technology, USA

Seth Marder, Georgia 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

Richard Martel, University of Montreal, Canada

Jian Ping Gong, Hokkaido University, Japan

Hedi Mattoussi, Florida State University, USA

Grace Gu, University of California, Berkeley, USA

David Mecerreyes, University of the Basque

Country, Spain

Phillip Messersmith, University of California,

Berkeley, USA

Markus Niederberger, ETH Zürich, Switzerland

Laura Herz, University of Oxford, UK

Teri Odom, Northwestern University, USA

Jurriaan Huskens, University of Twente, Netherlands

Wee-Jun Ong, Xiamen University, Malaysia

Hiroshi Imahori, Kyoto University, Japan

Moon Jeong Park, Pohang University of

Lei Jiang, Beihang University, China

Science and Technology (POSTECH), Korea

Antoine Kahn, Princeton University, USA

Marie-Paule Pilani, Pierre and Marie Curie University, France

Vivek Polshettiwar, Tata Institute of Fundamental Research (TIFR), India

C N R Rao, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India

Erin Ratcliff, University of Arizona, USA

Vince Rotello, University of Massachusetts at Amherst, USA

David Scanlon, University College London, United Kingdom

Christine Schmidt, University of Florida, USA

Gregory D. Scholes, Princeton University, USA

Rachel Segalman, University of California

Santa Barbara, USA

Peter Skabar, 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 Vaidyanathan, IISER Pune, India

Aleks Vojvodic, University of Pennsylvania, USA

Elizabeth von Hauff, VU Amsterdam, The 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, USA

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.

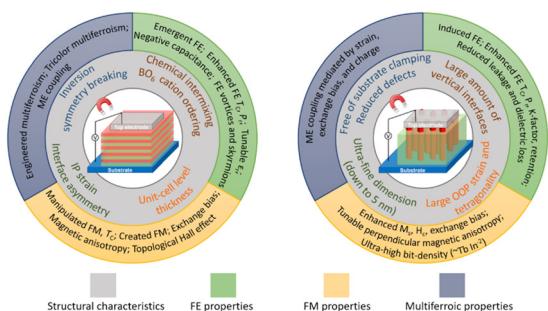
Registered charity number: 207890

REVIEWS

1060

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

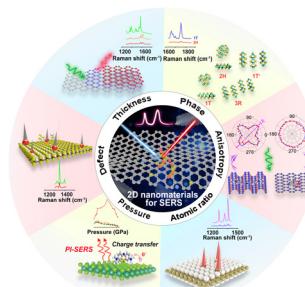
Judith L. MacManus-Driscoll,* Rui Wu* and Weiwei Li*



1087

Spotting the driving forces for SERS of two-dimensional nanomaterials

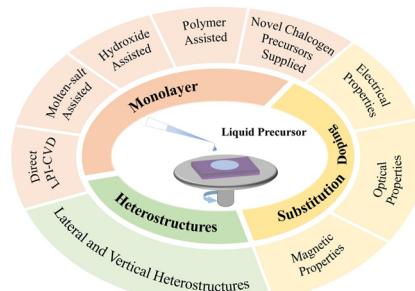
Jing Jin, Zhinan Guo,* Dianyuan Fan and Bing Zhao*



1105

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

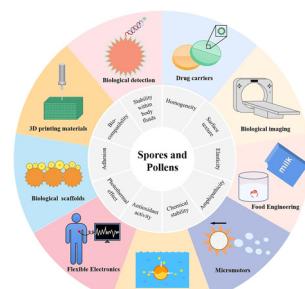
Huiyan Guan, Bei Zhao,* Weiwei Zhao and Zhenhua Ni*



1121

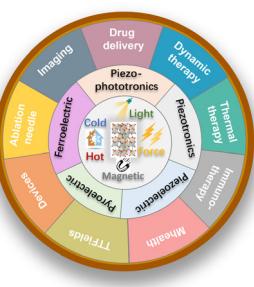
Extraordinary microcarriers derived from spores and pollens

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

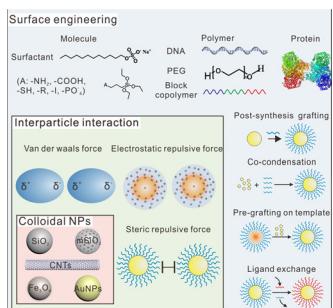


REVIEWS

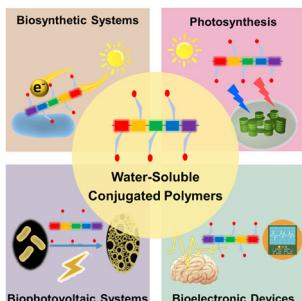
1140



1185

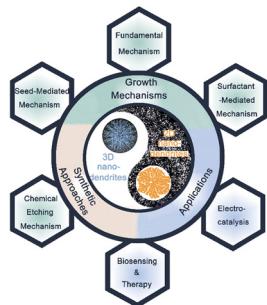


1210



MINIREVIEW

1234



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*

Surface engineering of colloidal nanoparticles

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

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*

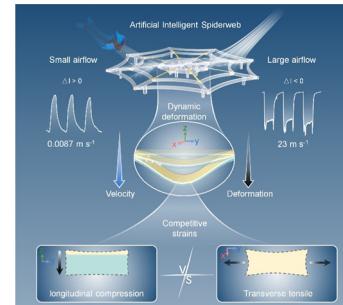
1050 | *Mater. Horiz.*, 2023, 10, 1047–1055

COMMUNICATIONS

1264

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

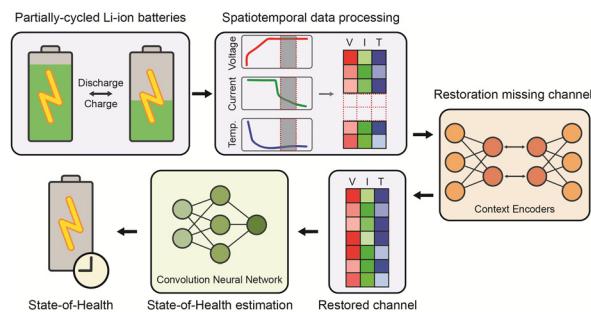
Wei Zhou, Peng Xiao,* Chang Zhang, Qing Yang and Tao Chen*



1274

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

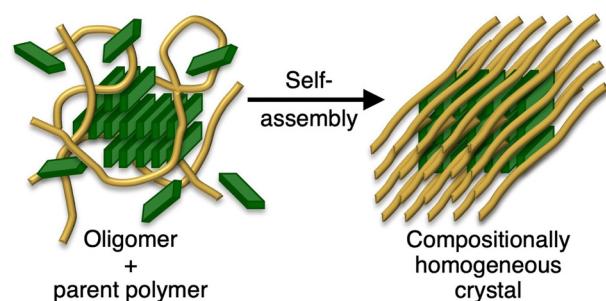
Seojoung Park, Hyunjun Lee, Zoe K. Scott-Nevros, Dongjun Lim, Dong-Hwa Seo, Yunseok Choi,* Hankwon Lim* and Donghyuk Kim*



1282

Oligoaniline-assisted self-assembly of polyaniline crystals

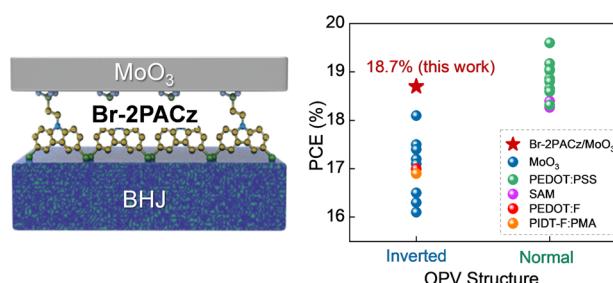
Ian M. Hill, Di Wu, Bohao Xu and Yue Wang*



1292

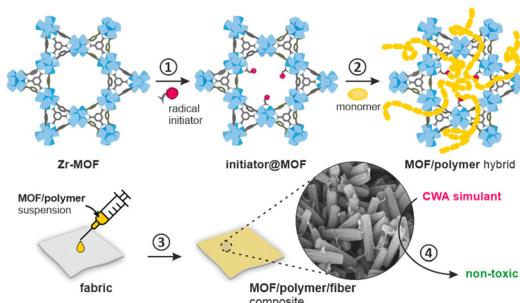
18.73% efficient and stable inverted organic photovoltaics featuring a hybrid hole-extraction layer

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*



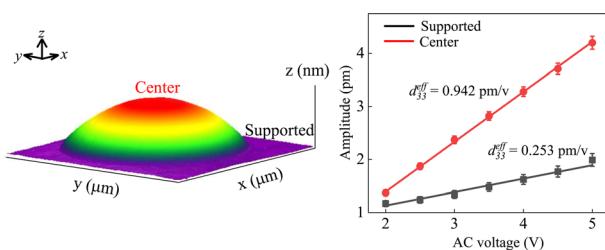
COMMUNICATIONS

1301

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

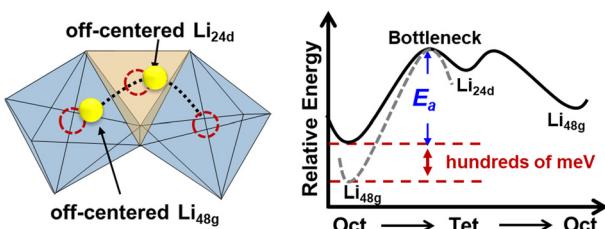
Marzena Pander, Rodrigo Gil-San-Millan, Pedro Delgado, Cristina Perona-Bermejo, Urszula Kostrzewska, Karol Kaczkowski, Dominik J. Kubicki,* Jorge A. R. Navarro* and Wojciech Bury*

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

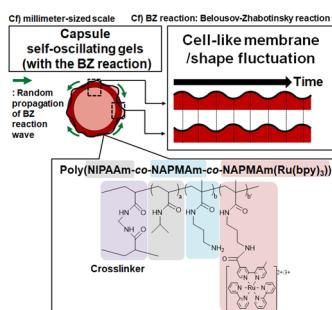
1324



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*

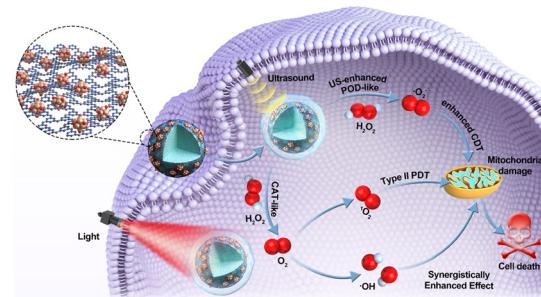


COMMUNICATIONS

1342

The direct catalytic synthesis of ultrasmall Cu_2O -coordinated carbon nitrides on ceria for multimodal antitumor therapy

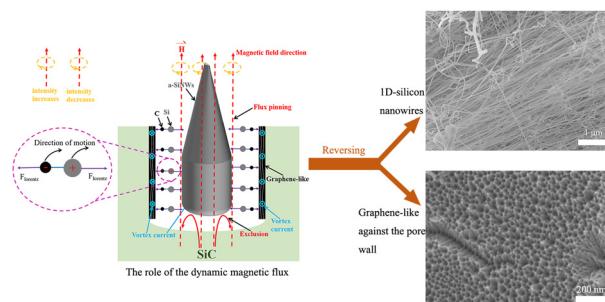
Lijian Cao, Ziyuan Feng, Ruiqian Guo, Qinyu Tian, Weiwen Wang, Xiao Rong, Mi Zhou, Chong Cheng,* Tian Ma* and Dawei Deng*



1354

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

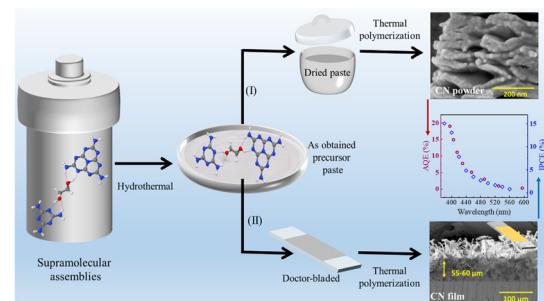
Wenting Zhou, Qiang Liu and Qingsong Huang*



1363

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

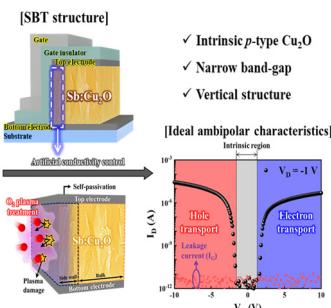
Sanjit Mondal, Gabriel Mark, Liel Abisdris, Junyi Li, Tirza Shmila, Jonathan Tzadikov, Michael Volokh, Lidan Xing and Menny Shalom*



1373

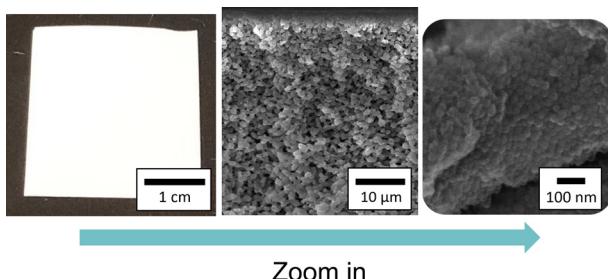
Ambipolar operation of progressively designed symmetric bidirectional transistors fabricated using single-channel vertical transistor and electrochemically prepared copper oxide

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



COMMUNICATIONS

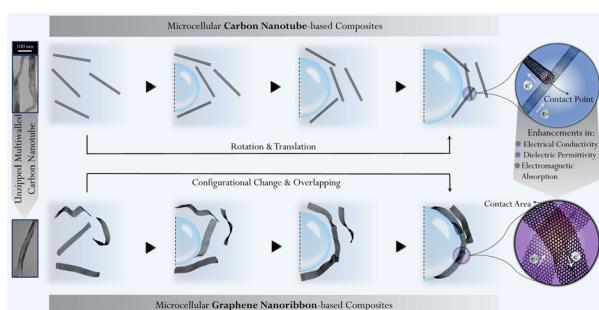
1385



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

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

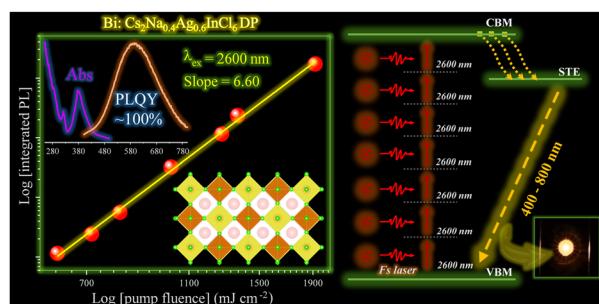
1392



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 Taromski, Hani E. Naguib, Aiping Yu and Chul B. Park*

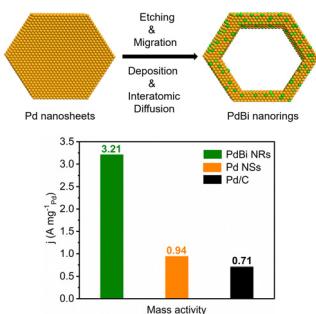
1406



Seven-photon absorption from $\text{Na}^+/\text{Bi}^{3+}$ -alloyed $\text{Cs}_2\text{AgInCl}_6$ 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*

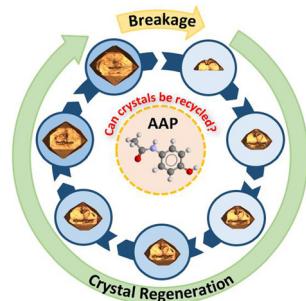


COMMUNICATIONS

1425

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

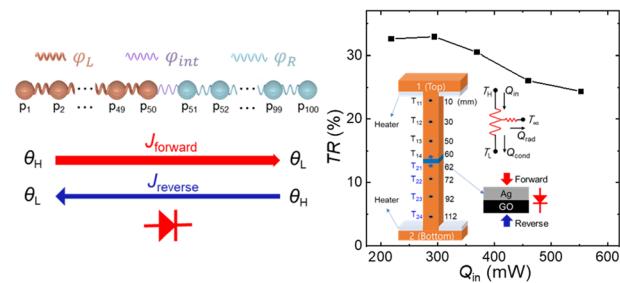
Isha Bade, Vivek Verma, Ian Rosbottom and Jerry Y. Y. Heng*



1431

Solid-state thermal rectification of bilayers by asymmetric elastic modulus

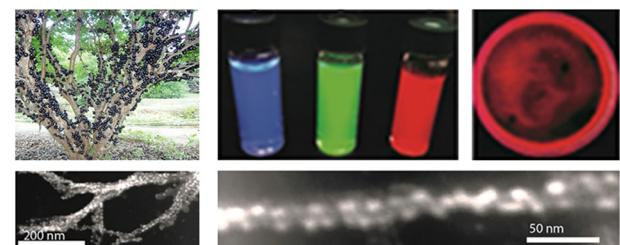
Junbyeong Lee, Seokjae Cha, Byung Ho Lee, Agha Aamir Jan, Rijin Kizhakkekara, Jaehun Yang, Moon Ki Kim* and Seunghyun Baik*



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*

