

# Journal of Materials Chemistry A

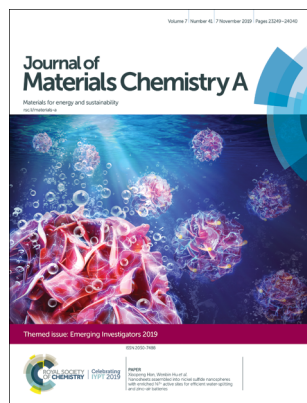
Materials for energy and sustainability

[rsc.li/materials-a](http://rsc.li/materials-a)

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.

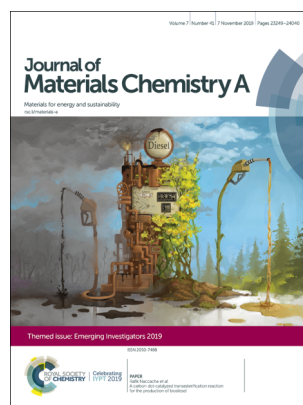
## IN THIS ISSUE

ISSN 2050-7488 CODEN JMCAET 7(41) 23249–24040 (2019)



### Cover

See Xiaopeng Han, Wenbin Hu *et al.*, pp. 23787–23793. Image reproduced by permission of Xiaopeng Han from *J. Mater. Chem. A*, 2019, 7, 23787.



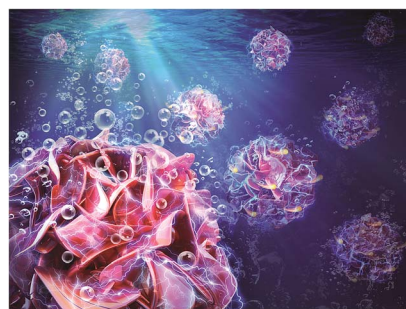
### Inside cover

See Rafik Naccache *et al.*, pp. 23794–23802. Image reproduced by permission of Rafik Naccache from *J. Mater. Chem. A*, 2019, 7, 23794.

## PROFILE

23267

**Journal of Materials Chemistry A profiles: contributors to the Emerging Investigators 2019 issue**

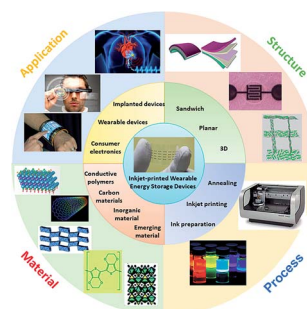


## REVIEWS

23280

**Scalable nanomanufacturing of inkjet-printed wearable energy storage devices**

Tao-Tse Huang and Wenzhuo Wu\*



## Editorial Staff

### Executive Editor

Sam Keltie

### Deputy Editor

Lynn Murphy

### Editorial Production Manager

Jonathon Watson

### Senior Publishing Editors

Jack Busby, Sarah Anthony

### Development Editor

Rose Wedgbury

### Publishing Editors

Matthew Blow, Rebecca Campbell, Chris Dias, Daniella Ferluccio, Laura Ghandhi, Emma Gorrell, Geraldine Hay, Molly Hope, Fiona Iddon, Alexandra Klein, Carole Martin, Rebecca Plant, Eve Rooks, Grace Thoburn, Ruth Zadik

### Editorial Assistant

Jane Chan

### Publishing Assistant

Julie-Ann Roszkowski

### Publisher

Jamie Humphrey

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

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

For pre-submission queries please contact

Sam Keltie, Executive Editor.

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

Journal of Materials Chemistry A (print: ISSN 2050-7488; electronic: ISSN 2050-7496) is published 48 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)

2019 Annual (print+electronic) subscription price: £1918; \$3983. 2019 Annual (electronic) subscription price: £1827; \$3793. 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)

# Journal of Materials Chemistry A

[rsc.li/materials-a](http://rsc.li/materials-a)

*Journal of Materials Chemistry A, B & C* cover high quality studies across all fields of materials chemistry. The journals focus on those theoretical or experimental studies that report new understanding, applications, properties and synthesis of materials. *Journal of Materials Chemistry A* covers materials with applications in energy & sustainability.

## Editorial Board

### Editor-in-Chief

Anders Hagfeldt, EPFL, Switzerland

### Associate Editors

Viola Birss, University of Calgary, Canada  
Goutam De, Institute of Nano Science and Technology (INST), Mohali, India  
Mohamed Eddaoudi, King Abdullah University of Science and Technology, Saudi Arabia  
Yun Jeong Hwang, Korea Institute of Science

and Technology, South Korea  
Kisuk Kang, Seoul National University, South Korea  
Zhiqun Lin, Georgia Institute of Technology, USA  
David Lou, Nanyang Technological University, Singapore  
Frank Osterloh, University of California, Davis, USA  
Shizhang Qiao, University of Adelaide, Australia

Jennifer Rupp, Massachusetts Institute of Technology, USA  
Stephen Skinner, Imperial College London, UK  
Magdalena Titirici, Imperial College London, UK  
Li-Zhu Wu, Technical Institute of Physics and Chemistry, China  
Yusuke Yamauchi, University of Queensland, Australia  
Zhen Zhou, Nankai University, China

## Advisory Board

P. Adelhelm, Friedrich Schiller Universität Jena, Germany  
C. Ania, CNRS Orleans, France  
C. Berlinguette, University of British Columbia, USA  
M. Chabinye, University of California, Santa Barbara, USA  
J.-S. Chen, Shanghai Jiao Tong University, China  
X. Feng, Dresden University of Technology, Germany  
G. Galli, University of Chicago, USA  
J. Huang, Northwestern University, USA

H. Imahori, Kyoto University, Japan  
T. Ishihara, Kyushu University, Japan  
S. Islam, University of Bath, UK  
B. Kim, KAIST, Korea  
D.-H. Kim, Ewha Womens University, Korea  
J. Li, Rutgers University, USA  
B. Lotsch, Max Planck Institute for Solid State Research, Stuttgart, Germany  
C.-B. Mullins, University of Texas at Austin, USA  
A. K. Nandi, IACS, India  
L. Nazar, University of Waterloo, Canada  
M. Niederberger, ETH Zürich, Switzerland

C. Osuji, Yale University, USA  
Z. Schnepp, University of Birmingham, UK  
Y. Shimakawa, Kyoto University, Japan  
C.-Y. Su, Sun Yat-Sen University, China  
V. Thangadurai, University of Calgary, Canada  
M. Wei, Beijing University of Chemical Technology, China  
Y.-J. Xu, Fuzhou University, China  
X.-S. Zhao, University of Queensland, Australia  
G. Zheng, Fudan University, China

## Information for Authors

Full details on how to submit material for publication in *Journal of Materials Chemistry A* 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-a](http://rsc.li/materials-a). Submissions: The journal welcomes submissions of manuscripts for publication as Full Papers, Communications, Reviews, Highlights and Applications. Full Papers and Communications should describe original work of high quality and impact which must highlight the novel properties or applications (or potential properties/applications) of the materials studied.

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 2019.

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.

© The paper used in this publication meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

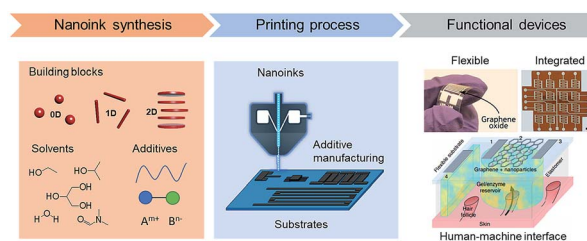
Registered charity number: 207890

## REVIEWS

23301

## Colloidal nanoparticle inks for printing functional devices: emerging trends and future prospects

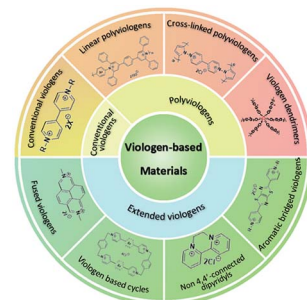
Minxiang Zeng and Yanliang Zhang\*



23337

## Viologen-inspired functional materials: synthetic strategies and applications

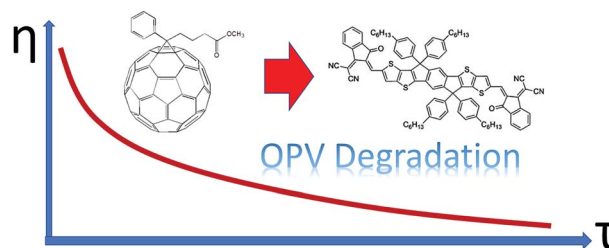
Junjie Ding, Caini Zheng, Luxin Wang, Chenbao Lu, Bin Zhang, Yu Chen,\* Mingqiang Li,\* Guangqun Zhai and Xiaodong Zhuang\*



23361

## From fullerene acceptors to non-fullerene acceptors: prospects and challenges in the stability of organic solar cells

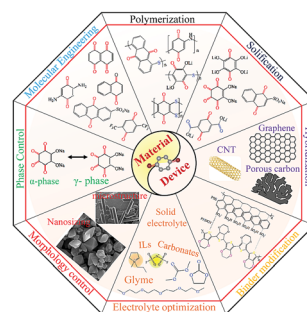
Emily M. Speller, Andrew J. Clarke, Joel Luke, Harrison Ka Hin Lee, James R. Durrant, Ning Li, Tao Wang, Him Cheng Wong, Ji-Seon Kim,\* Wing Chung Tsoi\* and Zhe Li\*



23378

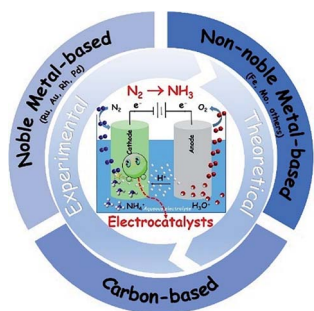
## Organic quinones towards advanced electrochemical energy storage: recent advances and challenges

Cuiping Han,\* Hongfei Li,\* Ruiying Shi, Tengfei Zhang, Jing Tong, Junqin Li and Baohua Li



## REVIEWS

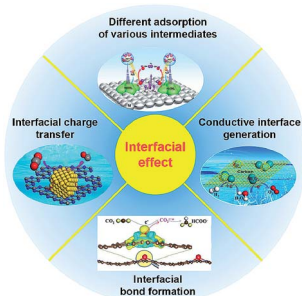
23416



### Ambient dinitrogen electrocatalytic reduction for ammonia synthesis

Aling Chen and Bao Yu Xia\*

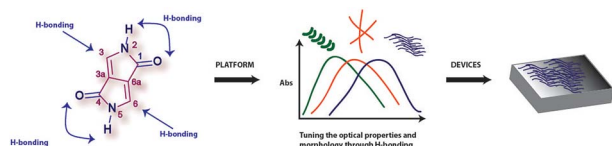
23432



### Interfacial effects in supported catalysts for electrocatalysis

Hao Li, Chen Chen, Dafeng Yan, Yanyong Wang, Ru Chen, Yuqin Zou\* and Shuangyin Wang\*

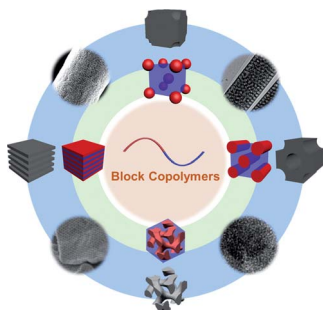
23451



### Hydrogen-bonded diketopyrrolopyrrole derivatives for energy-related applications

Amparo Ruiz-Carretero,\* Nelson Ricardo Ávila Roveló, Swann Militzer and Philippe J. Mésini

23476



### Block copolymer-based porous carbons for supercapacitors

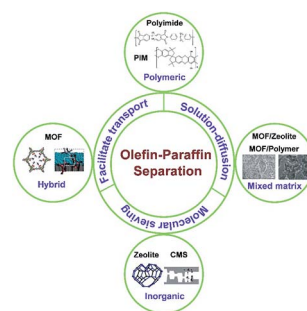
Tianyu Liu and Guoliang Liu\*

## REVIEWS

23489

**Olefin/paraffin separation through membranes: from mechanisms to critical materials**

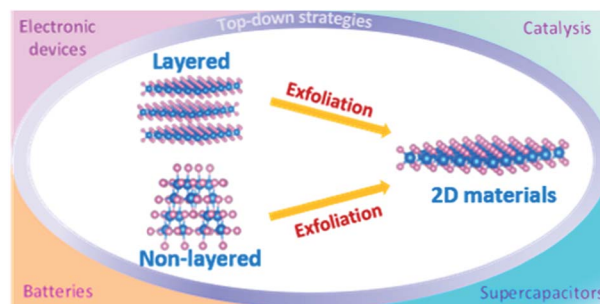
Junjun Hou, Pengchao Liu, Meihuizi Jiang, Lian Yu, Lianshan Li\* and Zhiyong Tang



23512

**Recent advances in exfoliation techniques of layered and non-layered materials for energy conversion and storage**

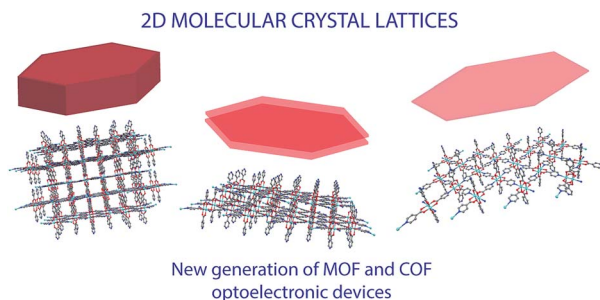
Pengcheng Tao, Shan Yao, Fangyan Liu, Biao Wang, Feng Huang and Mengye Wang\*



23537

**2D molecular crystal lattices: advances in their synthesis, characterization, and application**

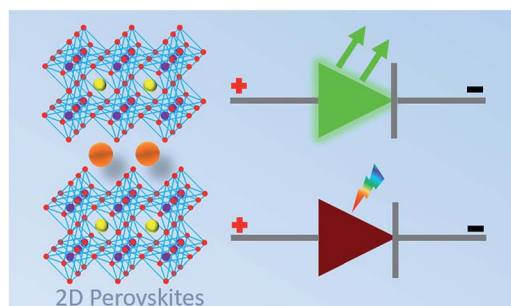
Marina A. Solomos, F. James Claire and Thomas J. Kempa\*



23563

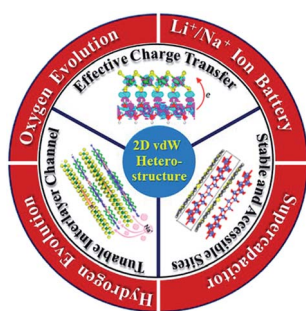
**Two-dimensional lead-free halide perovskite materials and devices**

Jie Wang, Jianchao Dong, Feifei Lu, Chenglin Sun,\* Qichun Zhang\* and Ning Wang\*





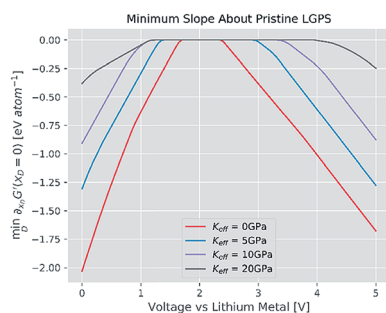
23577



### Multiple roles of a heterointerface in two-dimensional van der Waals heterostructures: insights into energy-related applications

Yuanzhi Zhu, Wenchao Peng, Yang Li, Guoliang Zhang, Fengbao Zhang and Xiaobin Fan\*

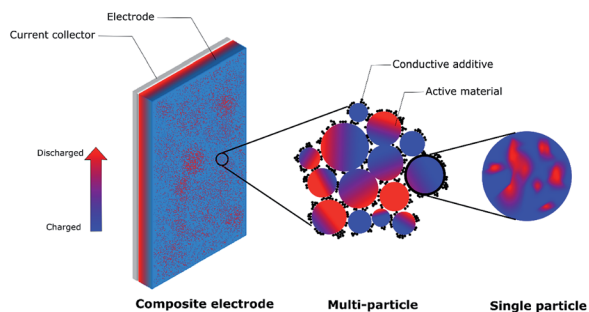
23604



### The effects of mechanical constriction on the operation of sulfide based solid-state batteries

William Fitzhugh, Luhan Ye and Xin Li\*

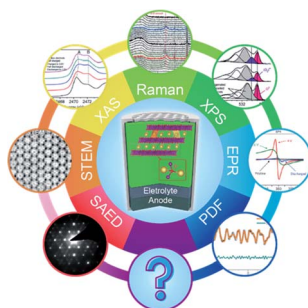
23628



### Probing and quantifying cathode charge heterogeneity in Li ion batteries

Yuxin Zhang, Zhijie Yang and Chixia Tian\*

23662



### Review on anionic redox in sodium-ion batteries

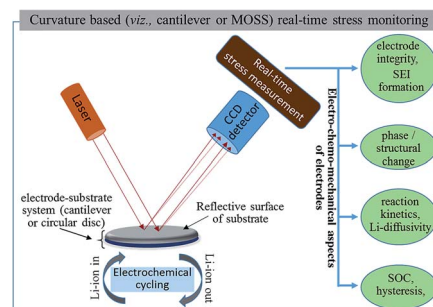
Hang Xu, Shaohua Guo\* and Haoshen Zhou

## REVIEWS

23679

## Real-time monitoring of stress development during electrochemical cycling of electrode materials for Li-ion batteries: overview and perspectives

Manoj K. Jangid and Amartya Mukhopadhyay\*

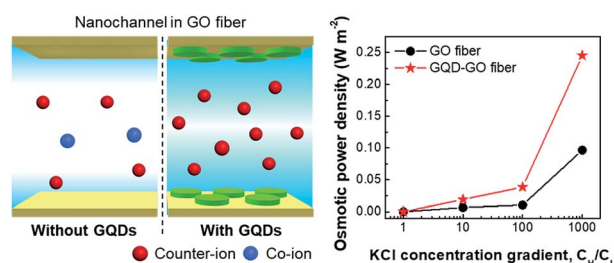


## COMMUNICATIONS

23727

## Graphene quantum dots/graphene fiber nanochannels for osmotic power generation

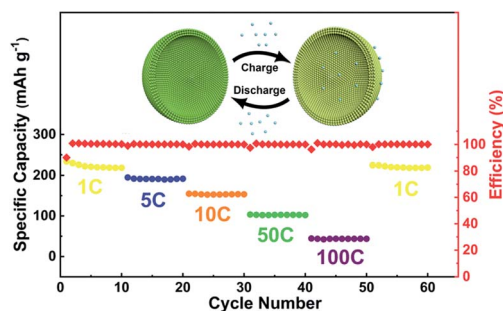
Ki Hyun Lee, Hun Park, Wonsik Eom, Dong Jun Kang, Sung Hyun Noh and Tae Hee Han\*



23733

## Hollow $TiO_2$ submicrospheres assembled by tiny nanocrystals as superior anode for lithium ion battery

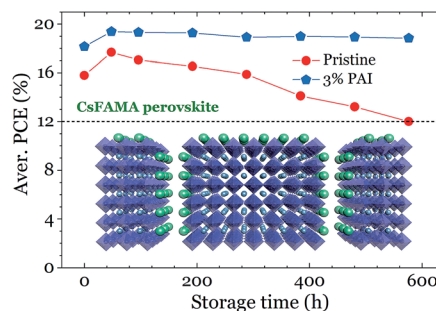
Jie Hou, Huimin Zhang, Jianjian Lin,\* Xueying Qiu, Wenshi Zhao, Xiaogang Sun, Yu Xiang, Hao Zhang,\* Guichuan Xing, Dehua Zheng, Guodong Li\* and Zhiyong Tang



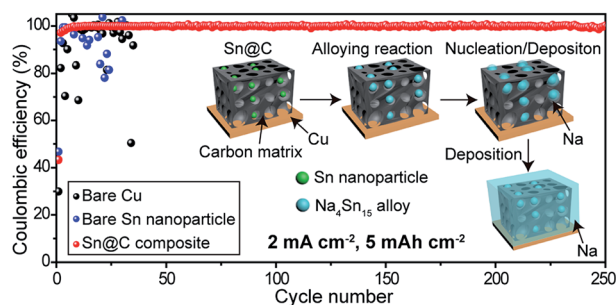
23739

## Self-assembled propylammonium cations at grain boundaries and the film surface to improve the efficiency and stability of perovskite solar cells

Chengbin Fei, Meng Zhou, Jonathan Ogle, Detlef-M. Smilgies, Luisa Whittaker-Brooks and He Wang\*



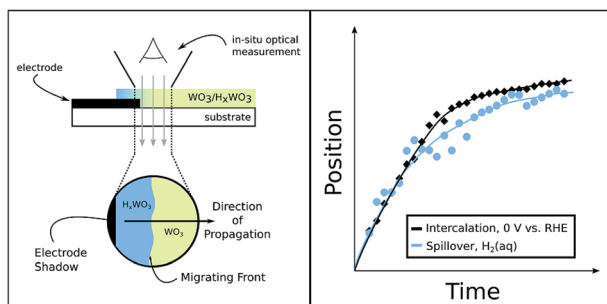
23747



### Tin nanoparticles embedded in a carbon buffer layer as preferential nucleation sites for stable sodium metal anodes

Huan Wang, Edward Matios, Chuanlong Wang, Jianmin Luo, Xuan Lu, Xiaofei Hu, Yiwen Zhang and Weiyang Li\*

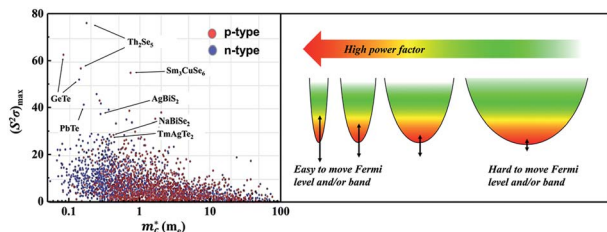
23756



### Comparisons of $\text{WO}_3$ reduction to $\text{H}_x\text{WO}_3$ under thermochemical and electrochemical control

Evan V. Miu and James R. McKone\*

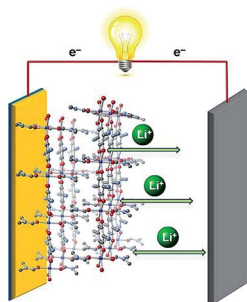
23762



### Inertial effective mass as an effective descriptor for thermoelectrics *via* data-driven evaluation

Ady Suwardi, Daniil Bash, Hong Kuan Ng, Jose Recatala Gomez, D. V. Maheswar Repaka, Pawan Kumar and Kedar Hippalgaonkar\*

23770



### Elucidating metal and ligand redox activities of a copper-benzoquinoid coordination polymer as the cathode for lithium-ion batteries

Cheng-Han Chang, An-Che Li, Ilja Popovs, Watchareeya Kaveevivitchai, Jeng-Lung Chen, Kai-Chun Chou, Ting-Shen Kuo and Teng-Hao Chen\*

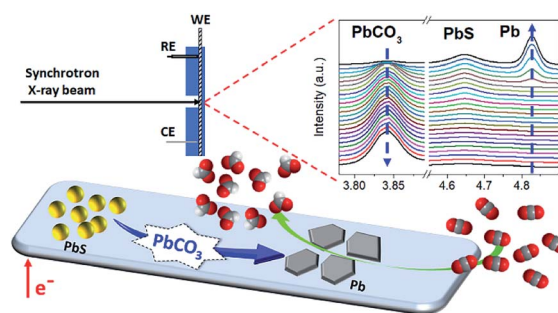


## COMMUNICATIONS

23775

### Revealing structural evolution of PbS nanocrystal catalysts in electrochemical CO<sub>2</sub> reduction using *in situ* synchrotron radiation X-ray diffraction

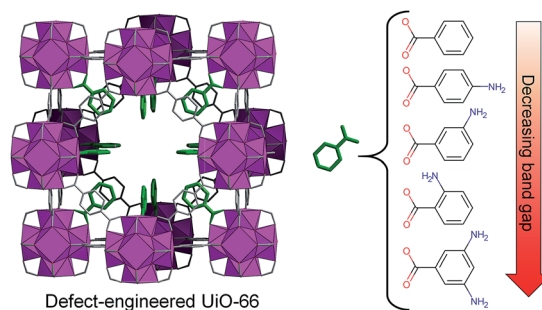
Zhiyong Zhang, Chang Liu, John T. Brosnahan, Hua Zhou, Wenqian Xu and Sen Zhang\*



23781

### Band gap modulation in zirconium-based metal-organic frameworks by defect engineering

Marco Taddei,\* Giulia M. Schukraft, Michael E. A. Warwick, Davide Tiana,\* Matthew J. McPherson, Daniel R. Jones and Camille Petit

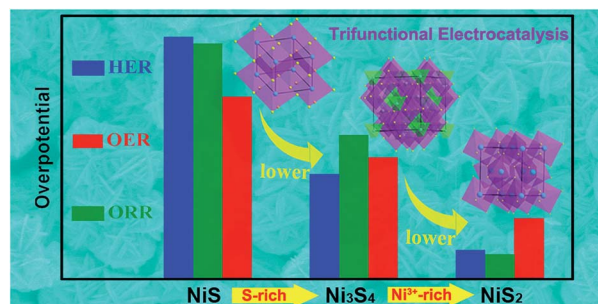


## PAPERS

23787

### Nanosheets assembled into nickel sulfide nanospheres with enriched Ni<sup>3+</sup> active sites for efficient water-splitting and zinc-air batteries

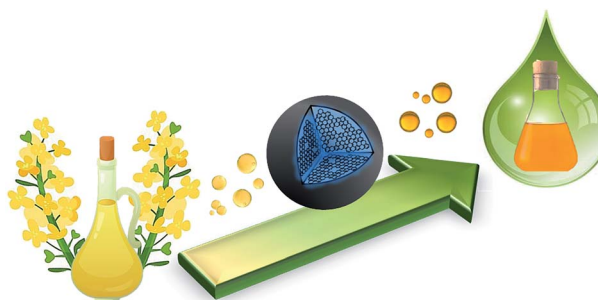
Xiangkai Shi, Xiaofei Ling, Lanlan Li, Cheng Zhong, Yida Deng, Xiaopeng Han\* and Wenbin Hu\*



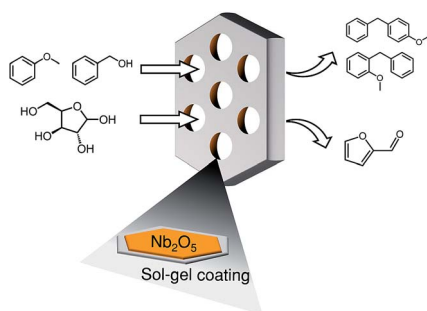
23794

### A carbon dot-catalyzed transesterification reaction for the production of biodiesel

Alexia Macina, Tayline V. de Medeiros and Rafik Naccache\*



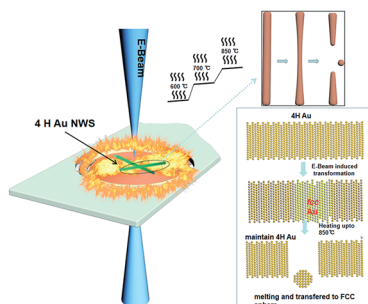
23803



### Post-synthesis deposition of mesoporous niobic acid with improved thermal stability by kinetically controlled sol-gel overcoating

Yuan-Peng Du, Florent H  roguel, Xuan Trung Nguyen and Jeremy S. Luterbacher\*

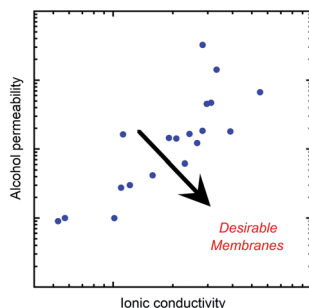
23812



### Ultra-stable 4H-gold nanowires up to 800   C in a vacuum

Qi Wang, Zhi Liang Zhao, Chao Cai, Hui Li and Meng Gu\*

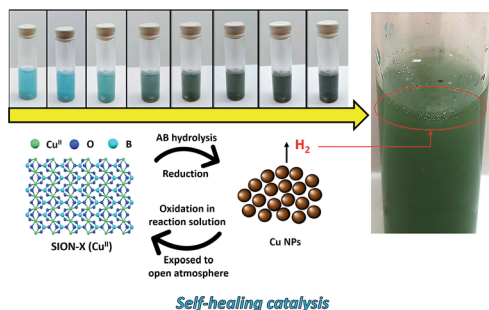
23818



### Preparation and characterization of crosslinked poly(vinylimidazolium) anion exchange membranes for artificial photosynthesis

Blaine M. Carter, Laura Keller, Matthias Wessling and Daniel J. Miller\*

23830



### Discovery of a self-healing catalyst for the hydrolytic dehydrogenation of ammonia borane

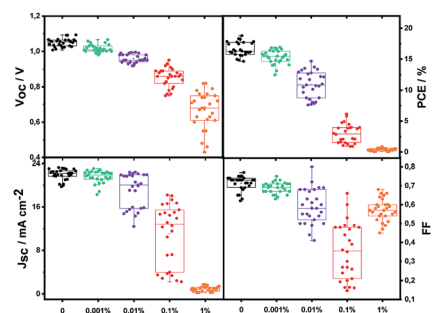
F. Pelin Kinik, Tu N. Nguyen, Emad Oveisi, Bardiya Valizadeh, Fatmah Mish Ebrahim, Andrzej G  dysiak, Mounir Mensi and Kyriakos C. Stylianou\*

## PAPERS

23838

### How far does the defect tolerance of lead-halide perovskites range? The example of Bi impurities introducing efficient recombination centers

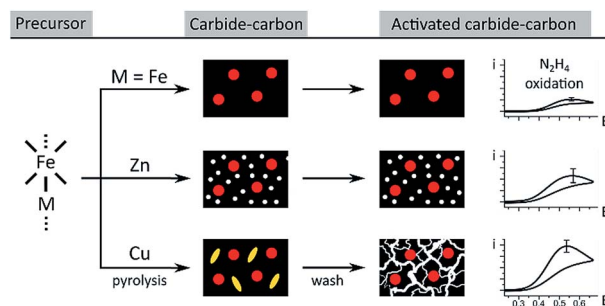
M. Yavari, F. Ebadi, S. Meloni, Z. S. Wang, T. C.-J. Yang, S. Sun, H. Schwartz, Z. Wang, B. Niesen, J. Durantini, P. Rieder, K. Tvingstedt, T. Buonassisi, W. C. H. Choy, A. Filippetti, T. Dittrich, S. Olthof, J. P. Correa Baena and W. Tress\*



23854

### Revealing structure–activity links in hydrazine oxidation: doping and nanostructure in carbide–carbon electrocatalysts

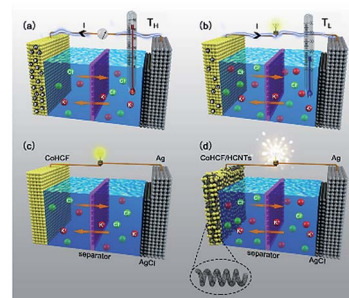
Tomer Y. Burshtein, Eliyahu M. Farber, Kasinath Ojha and David Eisenberg\*



23862

### A CoHCF system with enhanced energy conversion efficiency for low-grade heat harvesting

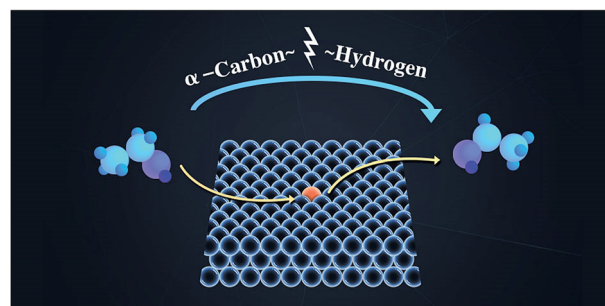
Jing Jiang, Hanqing Tian, Xinrui He, Qing Zeng, Yi Niu, Ting Zhou, Yuan Yang\* and Chao Wang\*



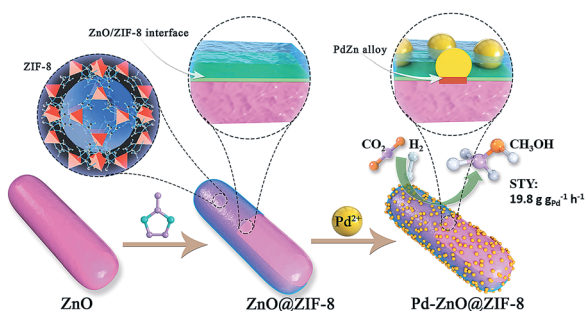
23868

### Selectivity for ethanol partial oxidation: the unique chemistry of single-atom alloy catalysts on Au, Ag, and Cu(111)

Hao Li,\* Wenrui Chai and Graeme Henkelman\*



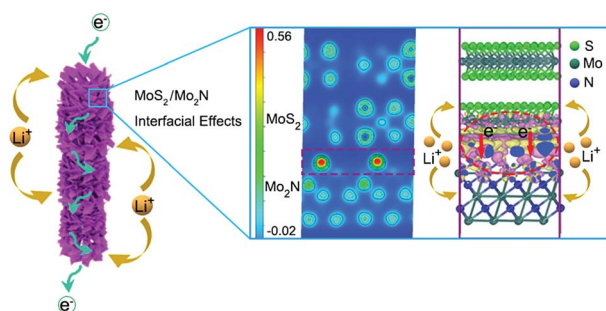
23878



### Confinement of subnanometric PdZn at a defect enriched ZnO/ZIF-8 interface for efficient and selective CO<sub>2</sub> hydrogenation to methanol

Xinliang Li, Guoliang Liu,\* Di Xu, Xinlin Hong\* and Shik Chi Edman Tsang

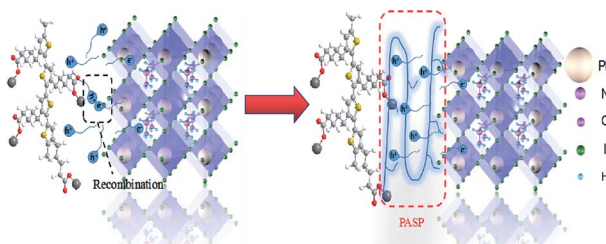
23886



### Rational construction of MoS<sub>2</sub>/Mo<sub>2</sub>N/C hierarchical porous tubular nanostructures for enhanced lithium storage

Song Yang, Yunqiang Zhang, Shulan Wang, Jian Shi, Xuan Liu\* and Li Li\*

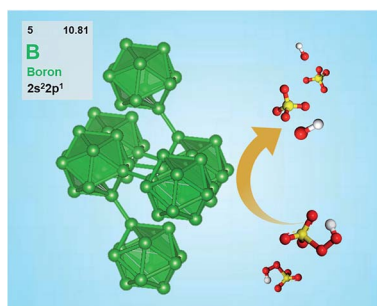
23895



### A polyaspartic acid sodium interfacial layer enhances surface trap passivation in perovskite solar cells

Boxin Wang, Fei Wu, Shiqing Bi, Jiyu Zhou, Jianqiu Wang, Xuanye Leng, Dongyang Zhang, Rui Meng, Baoda Xue, Chengzhong Zong,\* Linna Zhu, Yuan Zhang\* and Huiqiong Zhou\*

23904



### Origins of boron catalysis in peroxydisulfate activation and advanced oxidation

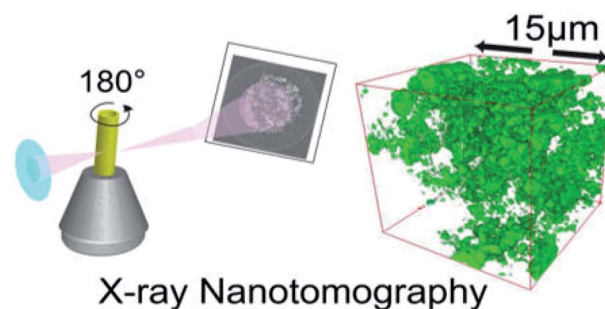
Xiaoguang Duan,\* Wenlang Li, Zhimin Ao, Jian Kang, Wenjie Tian, Huayang Zhang, Shih-Hsin Ho, Hongqi Sun and Shaobin Wang\*

## PAPERS

23914

## Visualizing percolation and ion transport in hybrid solid electrolytes for Li-metal batteries

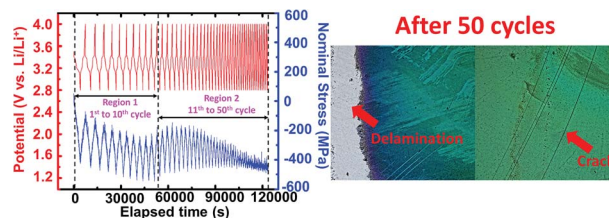
Wahid Zaman, Nicholas Hortance, Marm B. Dixit, Vincent De Andrade and Kelsey B. Hatzell\*



23922

Chemo-mechanical degradation in  $V_2O_5$  thin film cathodes of Li-ion batteries during electrochemical cycling

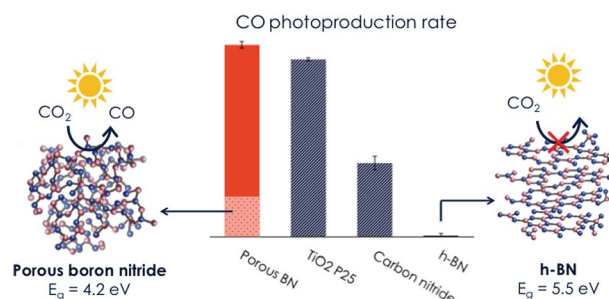
Yuwei Zhang, Yuting Luo, Cole Fincher, Sarbajit Banerjee and Matt Pharr\*



23931

Porous boron nitride for combined  $CO_2$  capture and photoreduction

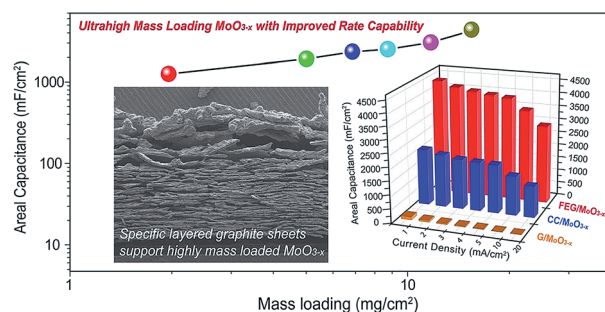
Ravi Shankar, Michael Sachs, Laia Francàs, Daphné Lubert-Perquel, Gwilherm Kerherve, Anna Regoutz and Camille Petit\*



23941

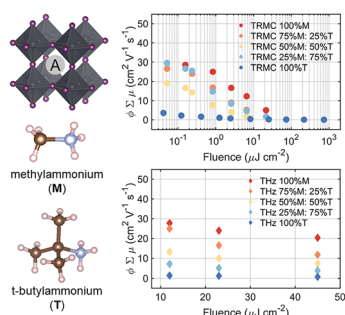
## Structural engineering to maintain the superior capacitance of molybdenum oxides at ultrahigh mass loadings

Ji-Chi Liu, Hui Li, Munkhbayer Batmunkh, Xue Xiao, Ying Sun, Qin Zhao, Xue Liu, Zi-Hang Huang\* and Tian-Yi Ma\*





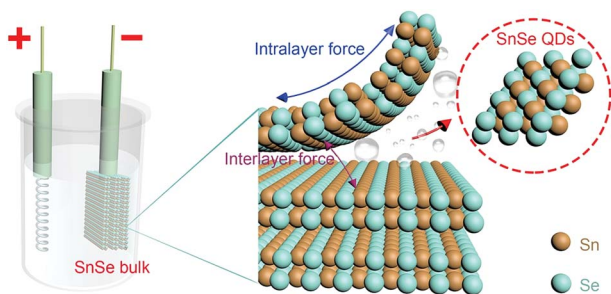
23949



### The effect of structural dimensionality on carrier mobility in lead-halide perovskites

Noor Titan Putri Hartono, Shijing Sun, María C. Gélvez-Rueda, Polly J. Pierone, Matthew P. Erodici, Jason Yoo, Fengxia Wei, Mouni Bawendi, Ferdinand C. Grozema, Meng-ju Sher, Tonio Buonassisi\* and Juan-Pablo Correa-Baena\*

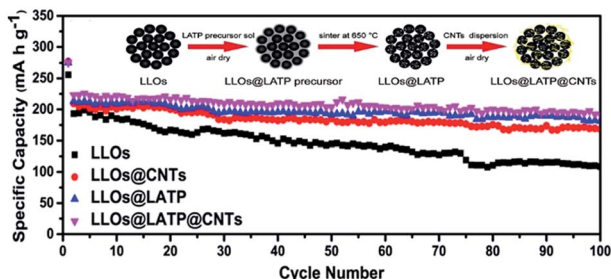
23958



### High yield electrochemical exfoliation synthesis of tin selenide quantum dots for high-performance lithium-ion batteries

Jing Li, Wei Liu, Cheng Chen, Xiaoxu Zhao, Zhizhan Qiu, Haomin Xu, Feng Sheng, Qifeng Hu, Yi Zheng, Ming Lin, Stephen J. Pennycook, Chenliang Su\* and Jiong Lu\*

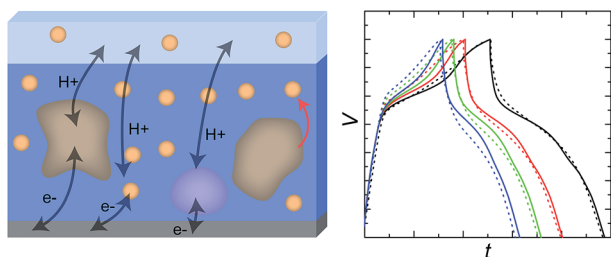
23964



### Enhanced structural stability and overall conductivity of Li-rich layered oxide materials achieved by a dual electron/lithium-conducting coating strategy for high-performance lithium-ion batteries

Dan Gao, Zhisen Zeng, Hongwei Mi, Lingna Sun, Xiangzhong Ren, Peixin Zhang and Yongling Li\*

23973



### Understanding the characteristics of conducting polymer-redox biopolymer supercapacitors

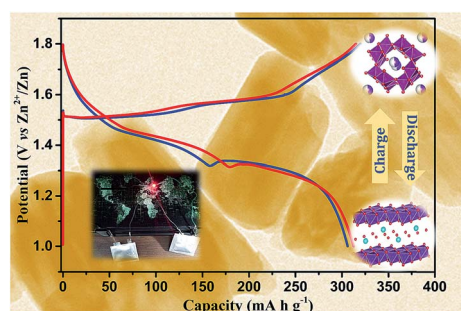
Musbaudeen O. Bamgbopa, Jesper Edberg, Isak Engquist, Magnus Berggren\* and Klas Tybrandt\*

## PAPERS

23981

**Cryptomelane  $K_{1.33}Mn_8O_{16}$  as a cathode for rechargeable aqueous zinc-ion batteries**

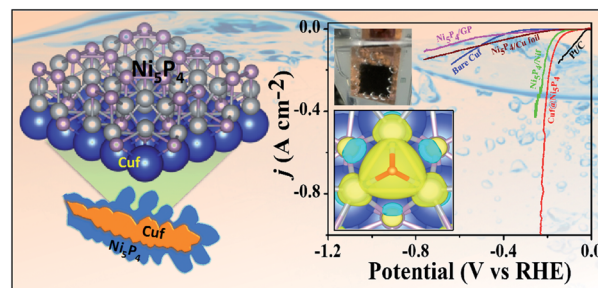
Krishnakanth Sada, Baskar Senthilkumar and Prabeer Barpanda\*



23989

**Single-phase  $Ni_5P_4$ -copper foam superhydrophilic and aerophobic core-shell nanostructures for efficient hydrogen evolution reaction**

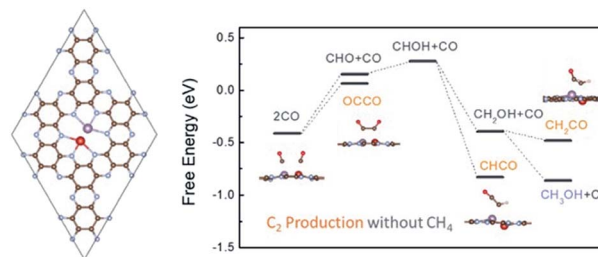
Manisha Das, Nityasagar Jena, Taniya Purkait, Navpreet Kamboj, Abir De Sarkar and Ramendra Sundar Dey\*



24000

**Improving selectivity of CO reduction *via* reducing the coordination of critical intermediates**

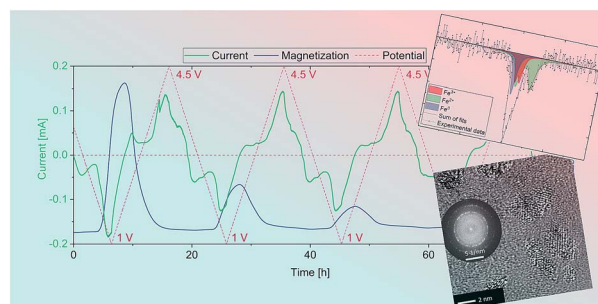
Yifan Li, Yumin Qian, Yujin Ji, Hui Li\* and Yuanyue Liu\*



24005

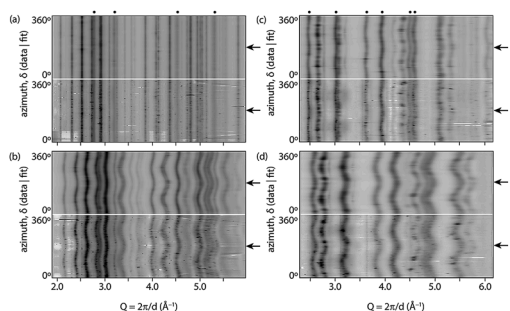
**Reversible control of magnetism: on the conversion of hydrated  $FeF_3$  with Li to Fe and  $LiF$** 

Ruby Singh, Ralf Witte, Xiaoke Mu, Torsten Brezesinski, Horst Hahn, Robert Kruk and Ben Breitung\*



## PAPERS

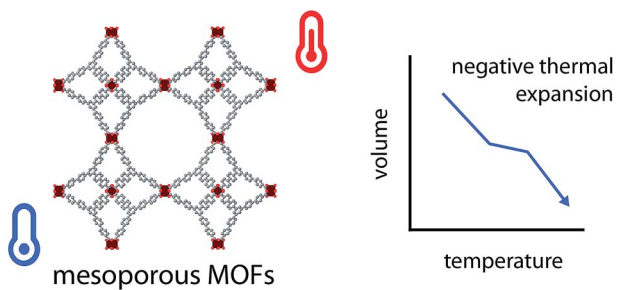
24012



### Lattice strain and texture analysis of superhard $\text{Mo}_{0.9}\text{W}_{1.1}\text{BC}$ and $\text{ReWC}_{0.8}$ via diamond anvil cell deformation

Marcus Parry, Samantha Couper, Aria Mansouri Tehrani, Anton O. Oliynyk, Jakoah Brgoch, Lowell Miyagi and Taylor D. Sparks\*

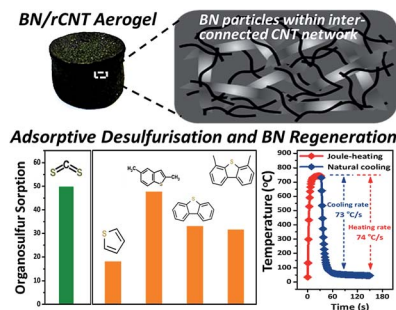
24019



### Assessing negative thermal expansion in mesoporous metal–organic frameworks by molecular simulation

Jack D. Evans,\* Johannes P. Dürholt, Stefan Kaskel and Rochus Schmid

24027



### Boron-nitride/carbon-nanotube hybrid aerogels as multifunctional desulfurisation agents

Dong Xia, Heng Li, Peng Huang, Jamie Mannering, Umair Zafar, Daniel Baker and Robert Menzel\*