

Journal of Materials Chemistry A

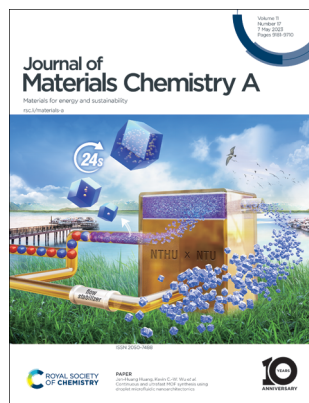
Materials for energy and sustainability

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.

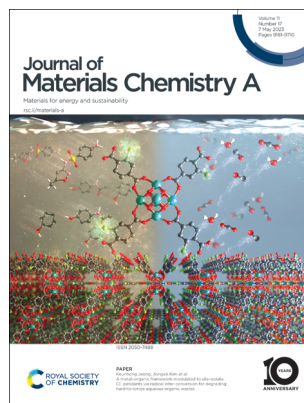
IN THIS ISSUE

ISSN 2050-7488 CODEN JMCAET 11(17) 9181–9710 (2023)



Cover

See Jen-Huang Huang, Kevin C.-W. Wu *et al.*, pp. 9427–9435. Image reproduced by permission of Kevin C.-W. Wu from *J. Mater. Chem. A*, 2023, **11**, 9427.



Inside cover

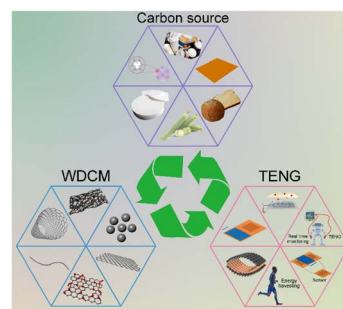
See Keunhong Jeong, Jongsik Kim *et al.*, pp. 9436–9454. Image reproduced by permission of Jongsik Kim from *J. Mater. Chem. A*, 2023, **11**, 9436.

REVIEWS

9194

Turning trash into treasure: recent advances in triboelectric nanogenerator based on waste-derived carbonized materials

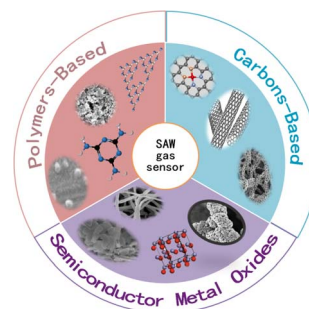
Wenxue Li, Yujia Lv, Dan Luo* and Zhong Lin Wang*



9216

Advances in sensing mechanisms and micro/nanostructured sensing layers for surface acoustic wave-based gas sensors

Xue Li, Wenfeng Sun, Wei Fu, Haifeng Lv, Xiaotao Zu,* Yuanjun Guo,* Des Gibson and Yong-Qing Fu*



Editorial Staff

Executive Editor

Michaela Muehlberg

Deputy Editor

Geraldine Hay

Editorial Production Manager

Jonathon Watson

Senior Publishing Editor

Isobel Tibbetts

Development Editor

Rose Wedgbury

Publishing Editors

Blake Baker, Matthew Blow, Chris Dias, Hemna Fathima, Juan Gonzalez, Ellie Griffiths, Rob Hinde, Sam Howell, Ash Hyde, Francesca Jacklin, Evie Karkera, Shruti Karnik, Sophie Koh, Tamara Kosikova, Brian Li, Sam Mansell, Carole Martin, Kirsty McRoberts, Yasmin Mehanna, Tiffany Rogers, Cat Schofield, Charu Storr-Vijay, Manman Wang, Ella White, Tom Williams

Editorial Assistant

Daniel Smith

Publishing Assistant

Julie-Ann Roszkowski

Publisher

Sam Keltie

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

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

Journal of Materials Chemistry A (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 0WE.

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 0WE, UK

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

2023 Annual (electronic) subscription price: £1968, \$4085. 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 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, contact marketing@rsc.org

Journal of Materials Chemistry A

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

Scientific Editors

Frank Osterloh, University of California, Davis, USA

Associate Editors

Veronica Augustyn, North Carolina State University, USA
Viola Birss, University of Calgary, Canada
Goutam De, S N Bose National Centre for Basic Sciences, India
Ghim Wei Ho, National University of Singapore, Singapore
Yun Jeong Hwang, Seoul National University, South Korea
Kisuk Kang, Seoul National University, South Korea

Subrata Kundu, Central Electrochemical Research Institute (CECRI), India
Dan Li, Jinan University, China
David Lou, Nanyang Technological University, Singapore
Yi-Chun Lu, Chinese University of Hong Kong, Hong Kong
Shizhang Qiao, University of Adelaide, Australia
Jennifer Rupp, Massachusetts Institute of Technology, USA

Miriam Unterlass, University of Konstanz, Germany
Lydia Wong, Nanyang Technological University, Singapore
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, Humboldt-University Berlin, Germany
R. Ahuja, Uppsala University, Sweden
C. Ania, CNRS Orleans, France
J.-B. Baek, Ulsan National Institute of Science and Technology, Korea
C. Berlinguette, University of British Columbia, Canada
K. Biswas, Jawaharlal Nehru Centre for Advanced Scientific Research, India
E. Bucher, University of Leoben, Austria
M. Chabinye, University of California, Santa Barbara, USA
A. Chattopadhyay, IIT Guwahati, India
J.-S. Chen, Shanghai Jiao Tong University, China
W. Chueh, Stanford University, USA
S. Cussen, University of Sheffield, UK
M. Eddaoudi, King Abdullah University of Science and Technology, Saudi Arabia
T. Edvinsson, Uppsala University, Sweden
X. Feng, Dresden University of Technology, Germany
J. Fleig, Dresden University of Technology, Germany
M. Florea, University of Bucharest, Romania
G. Galli, University of Chicago, USA
N. Garcia-Araez, University of Southampton, UK

G. Grancini, University of Pavia, Italy
J. Huang, Northwestern University, USA
H. Imahori, Kyoto University, Japan
T. Ishihara, Kyushu University, Japan
S. Islam, University of Bath, UK
F. Jiao, University of Delaware, USA
E. Kendrick, University of Birmingham, UK
B. Kim, KAIST, Korea
D.-H. Kim, Ewha Womens University, Korea
U. Kramm, TU Darmstadt, Germany
Y.J. Lee, Hanyang University, Korea
B. Li, Tsinghua University, China
J. Li, Rutgers University, USA
Z. Lin, National University of Singapore, Singapore
B. Lotsch, Max Planck Institute for Solid State Research, Stuttgart, Germany
J. Luo, Nankai University, China
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
A.F. Nogueira, University of Campinas, Brazil
C. Osuji, University of Pennsylvania, USA
S. Parker, University of Bath, UK
S. Patil, Indian Institute of Science, Bangalore, India
Z. Schnepp, University of Birmingham, UK

Z. Shao, Curtin University, Australia
Y. Shimakawa, Kyoto University, Japan
S. Skinner, Imperial College London, UK
M.C. Stefan, University of Texas at Dallas, USA
C.-Y. Su, Sun Yat-Sen University, China
S.-G. Sun, Xiamen University, China
V. Thangadurai, University of Calgary, Canada
M. Titirici, Imperial College London, UK
S. Uk Son, Sungkyunkwan University, Korea
E. Unger, Lund University, Sweden
R.-N. Vannier, ENSC Lille, France
M. Wang, Sun Yat-Sen University, China
M. Wei, Beijing University of Chemical Technology, China
E. Weiss, Northwestern University, USA
C. Williams, University of Oxford, UK
C. Xiong, Boise State University, USA
Y. Xu, University College London, UK
Y.-J. Xu, Fuzhou University, China
M. Ye, Xiamen University, China
Q. Zhang, Tsinghua 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. 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 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

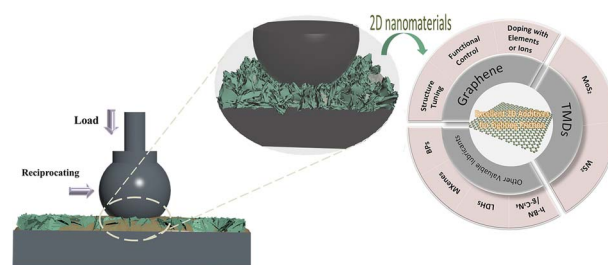


REVIEWS

9239

Recent advances of two-dimensional lubricating materials: from tunable tribological properties to applications

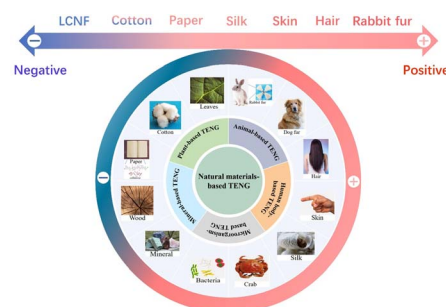
Xiaole Zhang, Tianhui Ren* and Zhipeng Li*



9270

Environmentally friendly natural materials for triboelectric nanogenerators: a review

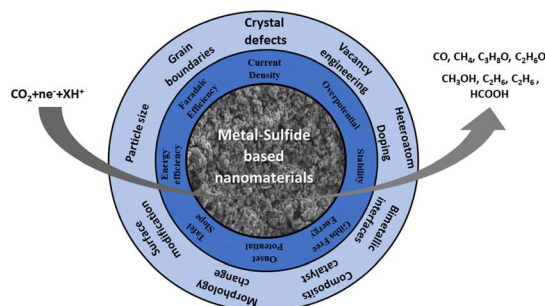
Songling Liu, Wangshu Tong,* Caixia Gao, Yulun Liu, Xinnan Li and Yihe Zhang*



9300

Metal sulfide-based nanomaterials for electrochemical CO₂ reduction

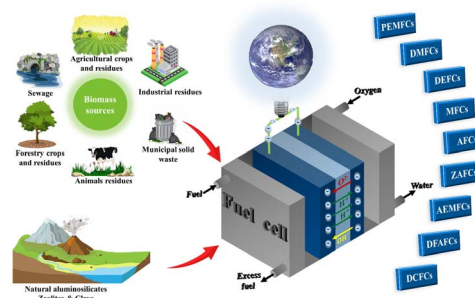
Anirban Mukherjee, Maryam Abdinejad,* Susanta Sinha Mahapatra and Bidhan Chandra Ruidas*



9333

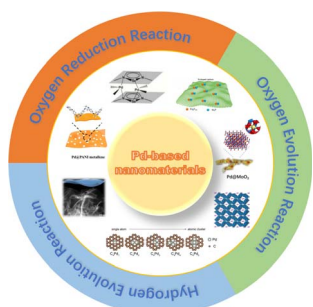
Application of biowaste and nature-inspired (nano) materials in fuel cells

Babak Jaleh,* Atefeh Nasri, Mahtab Eslamipana, Mahmoud Nasrollahzadeh,* Jacky H. Advani, Paolo Fornasiero and Manoj B. Gawande*



REVIEWS

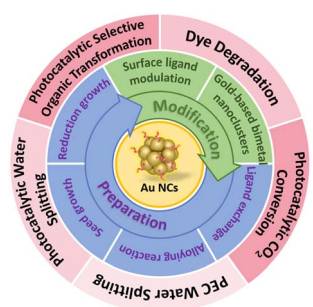
9383



Novel palladium-based nanomaterials for multifunctional ORR/OER/HER electrocatalysis

Hangxuan Li and Ge Li*

9401

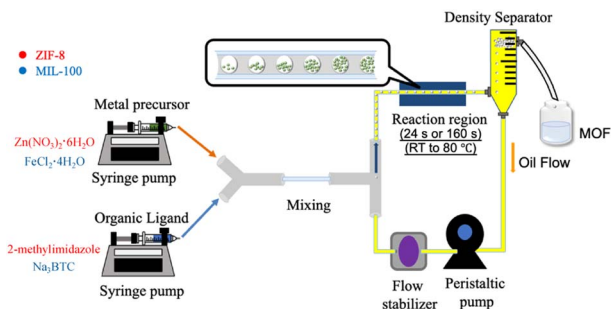


Atomically precise thiolate-protected gold nanoclusters: current advances in solar-powered photoredox catalysis

Hao Liang, Qing Chen, Qiao-Ling Mo, Yue Wu* and Fang-Xing Xiao*

PAPERS

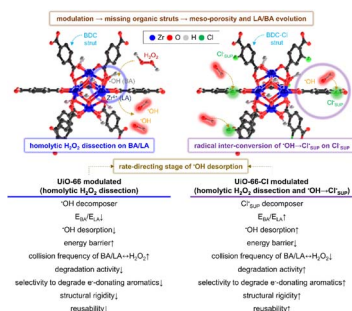
9427



Continuous and ultrafast MOF synthesis using droplet microfluidic nanoarchitectonics

Hsi-Yen Wu, Ching-Ling Wu, Weisheng Liao, Babasaheb M. Matsagar, Keng-Yao Chang, Jen-Huang Huang* and Kevin C.-W. Wu*

9436



A metal–organic framework modulated to site-isolate Cl[−] pendants via radical inter-conversion for degrading hard-to-ionize aqueous organic wastes

Minsung Kim, Md Al Mamunur Rashid, Yun Jeong Choe, Sang Hoon Kim, Jung-Hyun Lee, Keunhong Jeong* and Jongsik Kim*

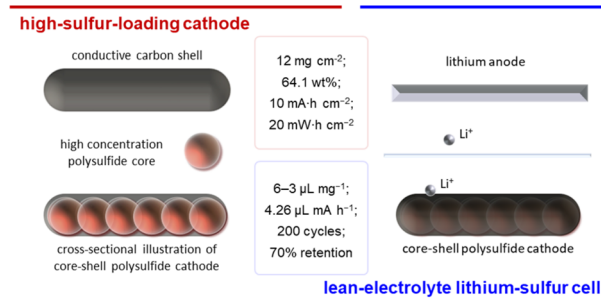


PAPERS

9455

Integrated high-sulfur-loading polysulfide/carbon cathode in lean-electrolyte cell toward high-energy-density lithium–sulfur cells with stable cyclability

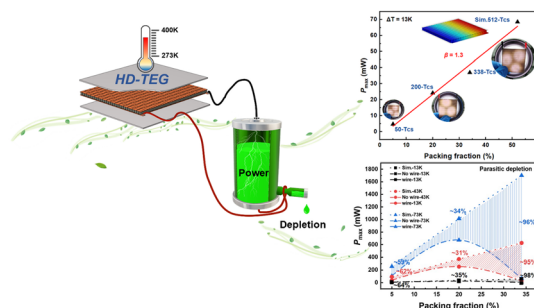
Yun-Chen Wu and Sheng-Heng Chung*



9464

Optimizing the output performance and parasitic depletion of Bi₂Te₃-based thermoelectric generators by using a high-density approach

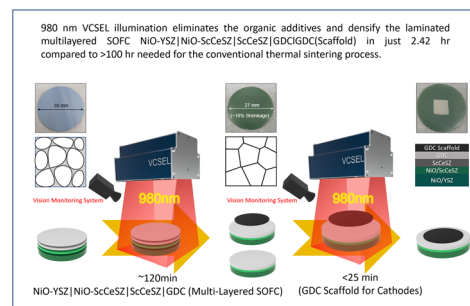
Yu Tian, Guang-Kun Ren,* Zhifang Zhou, Zhijie Wei, Wen Fang, Jiangfeng Song, Yan Shi, Xiaohong Chen* and Yuan-Hua Lin



9474

Vertical-cavity surface-emitting laser (VCSEL)-based ultrafast photonic sintering of solid oxide fuel cells (SOFCs): prospects for time-efficient/two-dimensional scalability to large-sized SOFCs

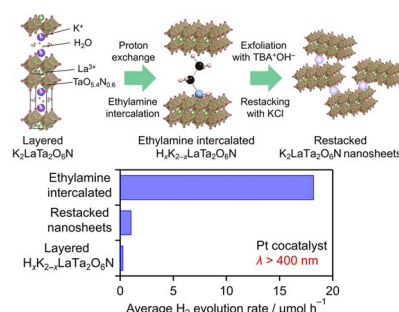
Jaehwan Kim, Saeed Ur Rehman, Myeong-Ill Lee, Amjad Hussain, Youngsu Noh, Jiwon Oh, Wonseck Ku, Na-Eui Kwak, Do-Hyeong Kim, Heesu Hwang, Hee-Sung Yoon, Seungho Park,* Seung-Bok Lee* and Jin-Ha Hwang*



9485

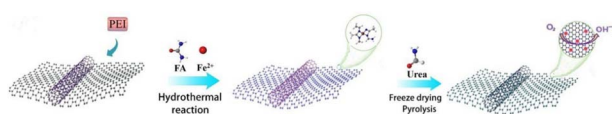
Interlayer modification and single-layer exfoliation of the Ruddlesden–Popper perovskite oxynitride K₂LaTa₂O₆N to improve photocatalytic H₂ evolution activity

Yuta Shiroma, Hiroto Mogi, Takeaki Mashiko, Shuhei Yasuda, Shunta Nishioka, Toshiyuki Yokoi, Shintaro Ida, Koji Kimoto and Kazuhiko Maeda*



PAPERS

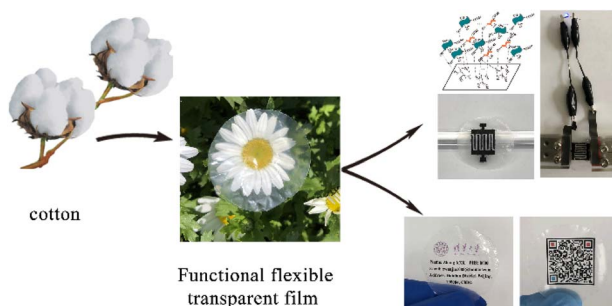
9493



Strengthening oxygen reduction activity based on the cooperation of pyridinic-N and graphitic-N for atomically dispersed Fe sites

Gengyu Xing, Guangying Zhang, Baoluo Wang, Miaomiao Tong, Chungui Tian, Lei Wang* and Honggang Fu*

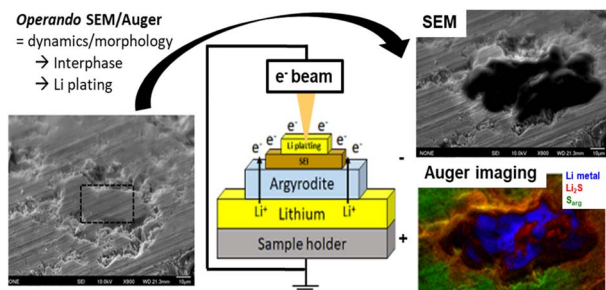
9504



From cotton to functional flexible transparent film for printable and flexible microsupercapacitor with strong bonding interface

Wenjie Zhang,* Bohan Li, Ruitao Lv, Huaming Li, Yuqing Weng, Wanci Shen, Feiyu Kang and Zheng-Hong Huang*

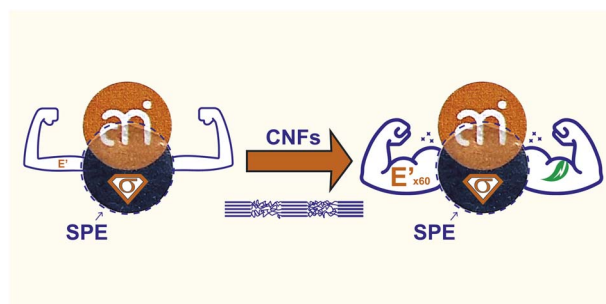
9512



Operando Auger/XPS using an electron beam to reveal the dynamics/morphology of Li plating and interphase formation in solid-state batteries

Julien Morey,* Jean-Bernard Ledeuil, Hervé Martinez and Lénaïc Madec*

9521



Cellulose nanofiber-reinforced solid polymer electrolytes with high ionic conductivity for lithium batteries

Cristina Prado-Martinez, Preston Sutton, Isabella Mombrini, Aristotelis Kamtsikakis, Worarin Meesorn, Christoph Weder, Ullrich Steiner and Ilja Gunkel*

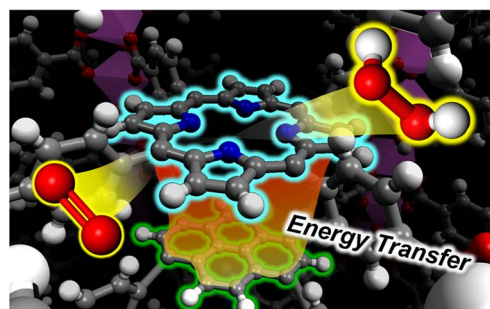


PAPERS

9530

Photosynthesis of hydrogen peroxide from dioxygen and water using aluminium-based metal–organic framework assembled with porphyrin- and pyrene-based linkers

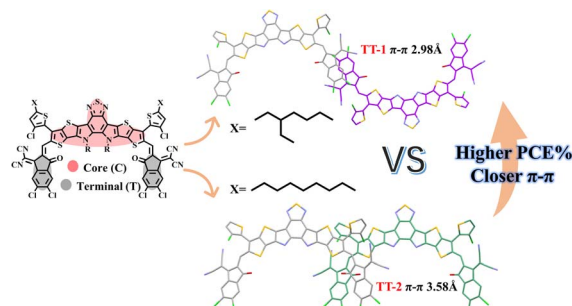
Yoshifumi Kondo, Kenta Hino, Yasutaka Kuwahara, Kohsuke Mori and Hiromi Yamashita*



9538

Achieving high performance organic solar cells with a closer π – π distance in branched alkyl-chain acceptors

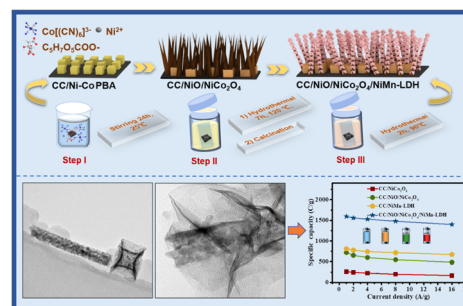
Pu Tan, Congcong Cao, Yue Cheng, Hui Chen, Hanjian Lai, Yulin Zhu, Liang Han, Jianfei Qu, Nan Zheng, Yuanzhu Zhang and Feng He*



9546

Constructing Ni–Co PBA derived 3D/1D/2D NiO/NiCo₂O₄/NiMn-LDH hierarchical heterostructures for ultrahigh rate capability in hybrid supercapacitors

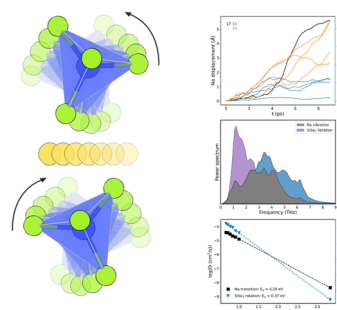
Dongyan Gao, Renning Liu, Dandan Han,* Pengcheng Xu, Ping Wang and Yen Wei*



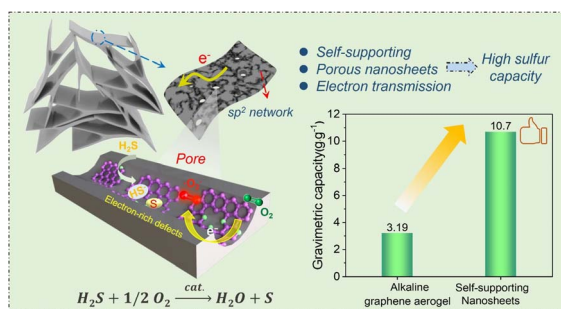
9555

Activating the paddle-wheel effect towards lower temperature in a new sodium-ion solid electrolyte, Na_{3.5}Si_{0.5}P_{0.5}Se₄

Yu Yang, Zhenming Xu, Chaohong Guan, Runxin Ouyang, Huirong Jing and Hong Zhu*



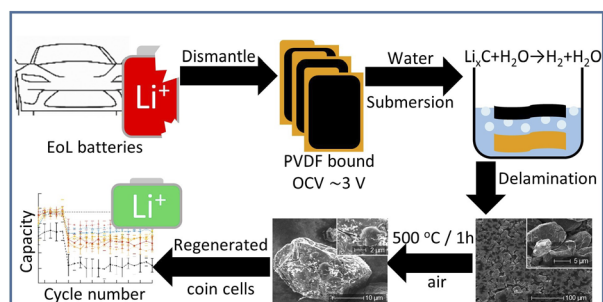
9566



Self-supporting nano-porous carbon nanosheet with organized sp^2 -C network for unprecedented catalytic performance in room-temperature H_2S oxidation

Feng Hu, Huan Chen, Zhengliang Zhang, Bo Niu, Yayun Zhang* and Donghui Long*

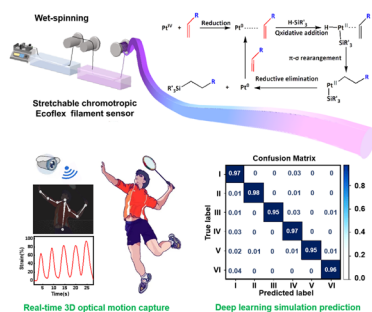
9579



Reclamation and reuse of graphite from electric vehicle lithium-ion battery anodes via water delamination

Alexander T. Sargent,* Zoë Henderson, Alex S. Walton, Ben F. Spencer, Luke Sweeney, Wendy R. Flavell, Paul A. Anderson, Emma Kendrick, Peter R. Slater* and Phoebe K. Allan*

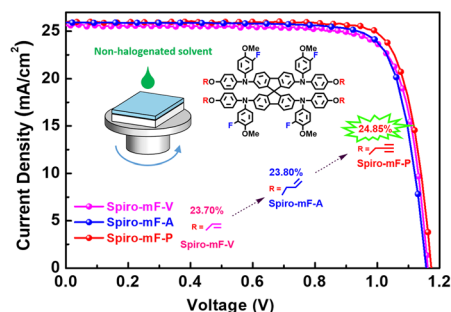
9597



Conductive chromotropic fiber filament sensors with ultrahigh stretchability for wearable sensing textiles toward 3D optical motion capture

Yufei Guo, Yongshi Guo, Jiawei Wu, Liying Wei, Shuhui Xia, Chuang Zhu* and Jianhua Yan*

9608



Perovskite solar cells approaching 25% PCE using side chain terminated hole transport materials with low concentration in a non-halogenated solvent process

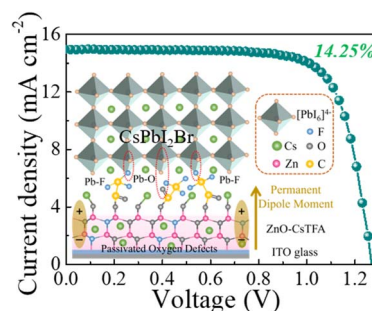
Zhiqing Xie, Yeongju Do, Seung Ju Choi, Ho-Yeol Park, Hyerin Kim, Jeonghyeon Kim, Donghyun Song, Thavamani Gokulnath, Hak-Beom Kim, In Woo Choi, Yimhyun Jo, Dong Suk Kim,* Seog-Young Yoon,* Young-Rae Cho* and Sung-Ho Jin*



9616

Targeting the imperfections at the ZnO/CsPbI₂Br interface for low-temperature carbon-based perovskite solar cells

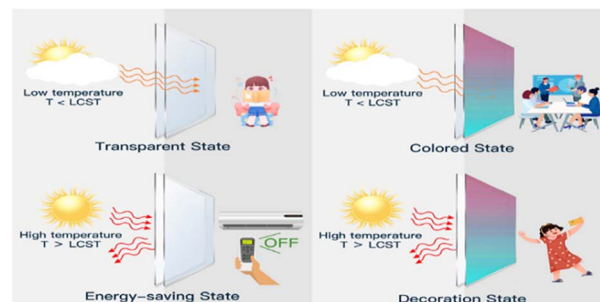
Xiang Zhang, Dan Zhang, Tonghui Guo, Junjie Zou, Junjun Jin, Chungui Zheng, Yuan Zhou, Zhenkun Zhu, Zhao Hu, Qiang Cao, Sujuan Wu, Jing Zhang and Qidong Tai*



9626

Ionic liquid–polymer thermochromic electrolytes with a wide and tunable LCST for application in multi-stimuli-responsive optical modulation

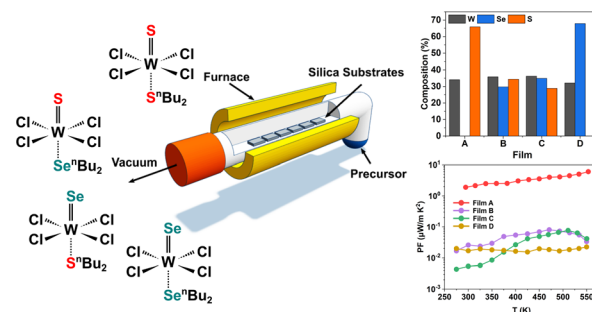
Hao Wu, Mi Wang,* Wanbao Wu, De Bai, Yihong Liang, Shunyou Hu, Wen Yu, Peng He* and Jiaheng Zhang*



9635

Tungsten dichalcogenide WS₂Se_{2-2x} films via single source precursor low-pressure CVD and their (thermo-)electric properties

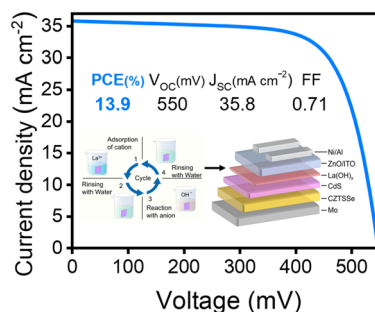
V. Sethi, D. Runacres, V. Greenacre, Li Shao, A. L. Hector, W. Levason, C. H. de Groot, G. Reid* and R. Huang*



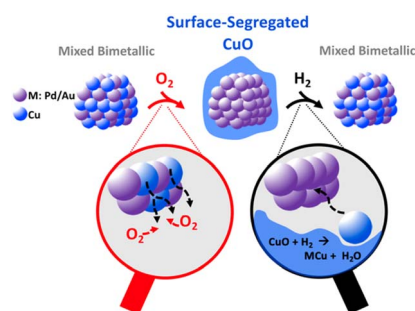
9646

Lanthanum-induced synergetic carrier doping of heterojunction to achieve high-efficiency kesterite solar cells

Kang Yin, Licheng Lou, Jinlin Wang, Xiao Xu, Jiazheng Zhou, Jiangjian Shi,* Dongmei Li, Huijue Wu, Yanhong Luo* and Qingbo Meng*



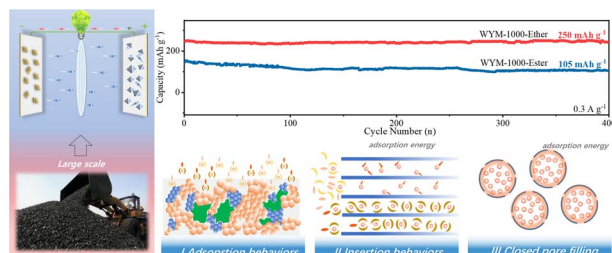
9654



Exploring the mobility of Cu in bimetallic nanocrystals to promote atomic-scale transformations under a reactive gas environment

Jette K. Mathiesen,^{*} Sofie Colding-Fagerholt, Kim D. Jensen, Jack K. Pedersen, Tom Vosch, Jan Rossmeisl, Stig Helveg and Kirsten M. Ø. Jensen^{*}

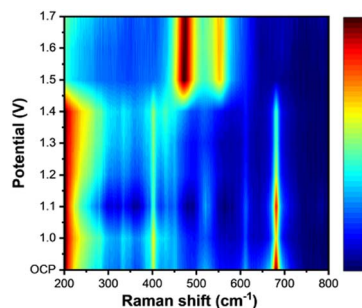
9668



Tailoring natural anthracite carbon materials towards considerable electrochemical properties with exploration of ester/ether-based electrolyte

Yu Dong, Shaohui Yuan, Wenqing Zhao, Chenxing Yi, Zihao Zeng, Siyan Xie, Yue Yang, Wei Sun, Xiaobo Ji and Peng Ge^{*}

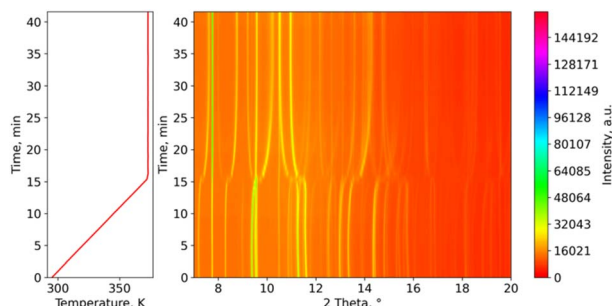
9682



Transforming NiFe layered double hydroxide into NiFeP_x for efficient alkaline water splitting

Jia Zhao, Nan Liao and Jingshan Luo^{*}

9691



Water vapour and gas induced phase transformations in an 8-fold interpenetrated diamondoid metal-organic framework

Aizhamal Subanbekova, Varvara I. Nikolayenko, Andrey A. Bezrukov, Debobroto Sensharma, Naveen Kumar, Daniel J. O'Hearn, Volodymyr Bon, Shi-Qiang Wang, Kyriaki Koupepidou, Shaza Darwish, Stefan Kaskel and Michael J. Zaworotko^{*}



9700

Efficiently predicting and synthesizing intrinsic highly fire-safe polycarbonates with processability

Ronghua Yu, Shengda Wang, Yue Zhu, Qianyu Li, Jiangnan You, Jian Qiu, Yanhui Wang, Jie Liu* and Tao Tang*

