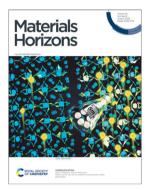
# **Materials Horizons**

## 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(8) 2709-3176 (2023)



## Cover

See Dario M. Bassani, Lionel Hirsch et al., pp. 2845-2853. Image reproduced by permission of CNRS - University of Bordeaux from Mater. Horiz., 2023, 10, 2845.

## **EDITORIALS**

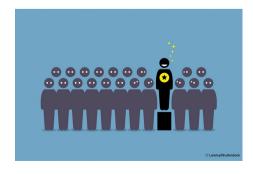
2723

Materials Horizons Emerging Investigator Series: Professor Derek Ho, City University of Hong Kong, China



2726

Outstanding Reviewers for Materials Horizons in 2022



#### **Editorial Staff**

**Executive Editor** 

Michaela Mühlberg

**Deputy Editor** Geraldine Hay

**Editorial Production Manager** 

Ionathon Watson

Senior Publishing Editor

Alex Metherell

**Development Editor** 

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. Simone Fabiano, Linköping University,

Sweden 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

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

## **Advisory Board**

Athina Anastasaki, ETH Zurich, Switzerland Markus Antonietti, Max Planck Intitute of Colloids & Interfaces, Germany David Beljonne, University of Mons, Belgium Chris Bettinger, Carnegie Mellon University,

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 Rebecca Gieseking, Brandeis University Jian Ping Gong, Hokkaido University, Japan Grace Gu, University of California, Berkeley,

Ritu Gupta, Indian Institute of Technology

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 Bayreu

Frederik Krebs, Elite Science, Denmark Katharina Landfester, Max Planck Institute for Polymer Research, Germany Guglielmo Lanzani , Italian 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 Eva Malmström Jonsson, KTH Royal Institute of Technology, Sweden Uttam Manna, Indian Institute of Technology-Guwahati, India

Seth Marder, University of Colorado Boulder,

Richard Martel, University of Montreal,

Hedi Mattoussi, Florida State University, USA David Mecerreyes , University of the Basque

Country, Spain Phillip Messersmith, University of California, Berkelev, 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

Vivek Polshettiwar, Tata Institute of 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, United Kingdom

Bernd M. Schmidt, Heinrich Heine University Düsseldorf, Germany 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 Kazuo Takimaya, RIKEN, Japan Luisa Torsi, University of Bari, Italy Ramanathan Vaidhyanathan, IISER Pune,

Aleks Vojvodic, University of Pennsylvania, USA

Elizabeth von Hauff, VU Amsterdam, The Netherlands

Aron Walsh, Imperial College London, UK Mengye Wang, Sun Yat-Sen University, China 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 Iihong Yu, Iilin 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 Nan Zhang, Hunan University, China Dongyuan Zhao, Fudan University, China Ye Zhou, Shenzhen 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.

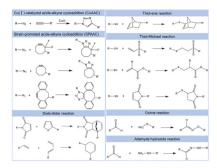
Registered charity number: 207890

## **REVIEWS**

## 2727

## Click chemistry for 3D bioprinting

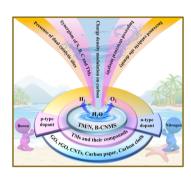
Lei Nie,\* Yanfang Sun, Oseweuba Valentine Okoro, Yaling Deng,\* Guohua Jiang and Amin Shavandi\*



## 2764

Emerging transition metal and carbon nanomaterial hybrids as electrocatalysts for water splitting: a brief review

Ayaz Muzammil, Rizwan Haider, Wenrui Wei, Yi Wan, Muhammad Ishaq, Muhammad Zahid,\* Waleed Yaseen and Xianxia Yuan\*



## 2800

Conductive polymer based hydrogels and their application in wearable sensors: a review

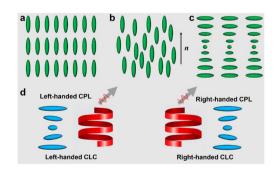
Dong Liu, Chenxi Huyan, Zibi Wang, Zhanhu Guo, Xuehua Zhang, Hamdi Torun, Daniel Mulvihill, Ben Bin Xu\* and Fei Chen\*



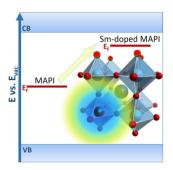
## 2824

Bioinspired humidity-responsive liquid crystalline materials: from adaptive soft actuators to visualized sensors and detectors

Ruochen Lan,\* Wenbo Shen, Wenhuan Yao, Jingyu Chen, Xinyu Chen and Huai Yang\*



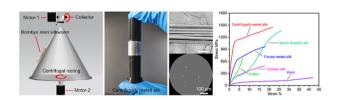
## 2845



## Redox-active ions unlock substitutional doping in halide perovskites

Zuzanna Molenda, Bastien Politi, Raphaël Clerc, Mamatimin Abbas, Sylvain Chambon, Dario M. Bassani\* and Lionel Hirsch\*

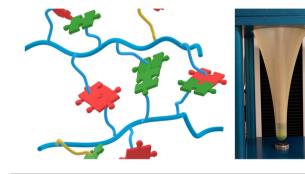
#### 2854



## High-performance artificially reeled silkworm silk via a multi-task and high-efficiency centrifugal reeling technique and its application in soft actuators

Teng Hou, Xianglong Li, Shu Liu, Jing Zhou, Yujing Bian, Lele Zhou, Mingbo Sun, Wenlong Zhou and Bin Yang\*

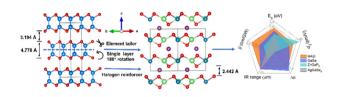
## 2868



## Puncture-resistant self-healing polymers with multi-cycle adhesion and rapid healability

Bingrui Li, Sirui Ge, Sheng Zhao, Kunyue Xing, Alexei P. Sokolov, Peng-Fei Cao\* and Tomonori Saito\*

## 2876



## Honeycomb layered topology construction for exceptional long-wave infrared nonlinear optical crystals

Jindong Chen, Chensheng Lin, Xiaotian Jiang, Guangsai Yang, Min Luo, Xin Zhao, Bingxuan Li, Guang Peng,\* Ning Ye,\* Zhanggui Hu, Jiyang Wang and Yicheng Wu

## 2883

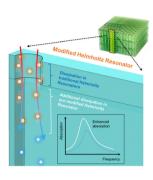
Room-temperature stacking disorder in layered covalent-organic frameworks from machinelearning force fields

Ju Huang, Seung-Jae Shin, Kasper Tolborg, Alex M. Ganose, Gabriel Krenzer and Aron Walsh\*



Harnessing cavity dissipation for enhanced sound absorption in Helmholtz resonance metamaterials

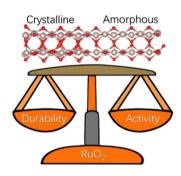
Xinwei Li, Xiang Yu, Jun Wei Chua and Wei Zhai\*



## 2904

Order-disorder engineering of RuO<sub>2</sub> nanosheets towards pH-universal oxygen evolution

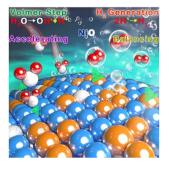
Yu Zhang, Yuefeng Zhang, Zhiyuan Zeng\* and Derek Ho\*



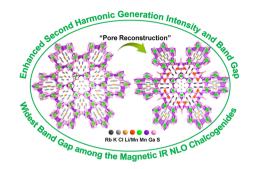
## 2913

Dual roles of sub-nanometer NiO in alkaline hydrogen evolution reaction: breaking the Volmer limitation and optimizing d-orbital electronic configuration

Fei Guo, Zeyi Zhang, Runzhe Chen, Yangyang Tan, Wei Wu, Zichen Wang, Tang Zeng, Wangbin Zhu, Caoxin Lin and Niancai Cheng\*

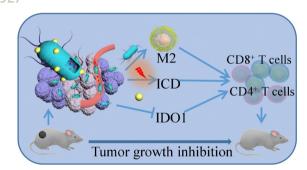


2921



Breaking the bottleneck of simultaneously wide band gap and large nonlinear optical coefficient by a "pore reconstruction" strategy in a salt-inclusion chalcogenide

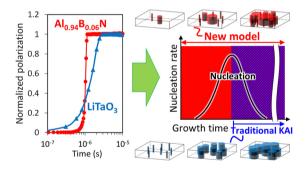
Shao-Min Pei, Bin-Wen Liu,\* Wen-Fa Chen, Xiao-Ming Jiang and Guo-Cong Guo\*



Bacteria engineered with intracellular and extracellular nanomaterials for hierarchical modulation of antitumor immune responses

Panpan Song, Xiaoqing Han, Xiumin Li, Yalin Cong, Yunyun Wu, Jiao Yan, Yanjing Wang, Xingbo Wang, Zhengzhi Mu, Liming Wang, Xi Li\* and Haiyuan Zhang\*

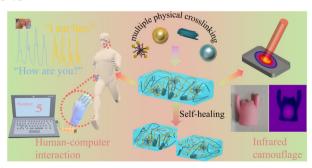
2936



Anomalously abrupt switching of wurtzite-structured ferroelectrics: simultaneous non-linear nucleation and growth model

Keisuke Yazawa,\* John Hayden, Jon-Paul Maria, Wanlin Zhu, Susan Trolier-McKinstry, Andriy Zakutayev and Geoff L. Brennecka\*

2945



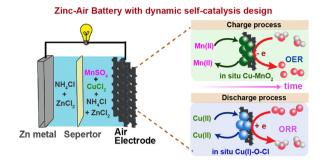
Self-healing liquid metal hydrogel for human-computer interaction and infrared camouflage

Xiaofei Li, Miao Jiang, Yiming Du, Xin Ding, Chao Xiao, Yanyan Wang, Yanyu Yang,\* Yizhi Zhuo, Kang Zheng, Xianglan Liu, Lin Chen, Yi Gong, Xingyou Tian and Xian Zhang\*

#### 2958

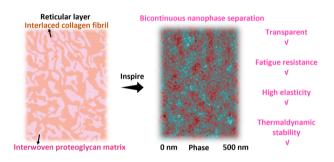
Dynamic-self-catalysis as an accelerated air-cathode for rechargeable near-neutral Zn-air batteries with ultrahigh energy efficiency

Tianran Zhang,\* Xiao Feng Lim, Shengliang Zhang, Jian Zheng, Xiangfeng Liu and Jim Yang Lee\*



Extremely strengthening fatigue resistance, elastic restorability and thermodynamic stability of a soft transparent self-healing network based on a dynamic molecular confinement-induced bioinspired nanostructure

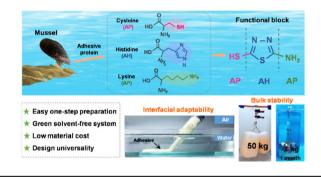
Tong Liu, ChuanLong Li, Hai Yao, FuYao Sun, Lin Wang, BoWen Yao, JianHua Xu\* and JiaJun Fu\*



## 2980

Achieving strong, stable, and durable underwater adhesives based on a simple and generic amino-acid-resembling design

Feng Li, Jiaying Mo, Zhicheng Zhang, Sheldon. Q. Shi, Jianzhang Li,\* Jinfeng Cao\* and Zuankai Wang\*



## 2989

Frontally polymerized foams: thermodynamic and kinetical aspects of front hindrance by particles

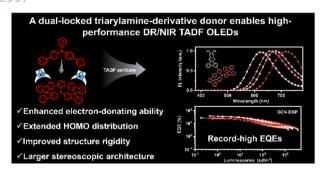
Petr Lepcio, John Daguerre-Bradford, Anna Maria Cristadoro, Markus Schuette and Alan J. Lesser\*

## Particles hindering front propagation in foams





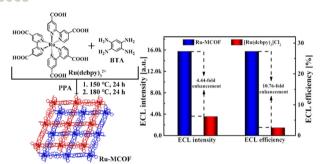
## 2997



A dual-locked triarylamine donor enables high-performance deep-red/NIR thermally activated delayed fluorescence organic light-emitting diodes

Hui Wang, Jia-Xiong Chen, Lu Zhou, Xi Zhang, Jia Yu, Kai Wang\* and Xiao-Hong Zhang\*

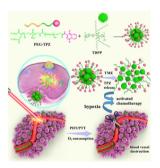
#### 3005



Highly stable Ru-complex-based metal-covalent organic frameworks as novel type of electrochemiluminescence emitters for ultrasensitive biosensing

Yang Yang, Haicheng Jiang, Jialu Li, Jialing Zhang, Shu-Zhen Gao, Mei-Ling Lu, Xin-Yue Zhang, Wenbin Liang, Xiaoqin Zou,\* Ruo Yuan\* and Dong-Rong Xiao\*

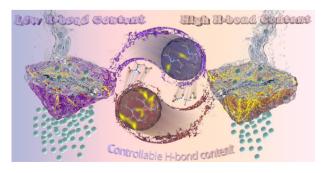
#### 3014



Tumor-microenvironment-responsive poly-prodrug encapsulated semiconducting polymer nanosystem for phototherapy-boosted chemotherapy

Jianwei Zhu, Yuning Zhang, Zheng Li, Xiaowen Bao, Yanfeng Zhou, Bo Ma, Ying Xie, Peiyu Yan, Zimei Wu,\* Qi Zhang,\* Jianhua Zou\* and Xiaoyuan Chen\*

#### 3024



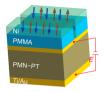
Controllable hydrogen-bonded poly(dimethylsiloxane) (PDMS) membranes for ultrafast alcohol recovery

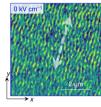
Tengyang Zhu, Jiayu Dong, Huan Liu and Yan Wang\*

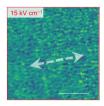
## 3034

## Switching magnetic strip orientation using electric fields

Aitian Chen, Hong-Guang Piao,\* Chenhui Zhang, Xiao-Ping Ma, Hanin Algaidi, Yinchang Ma, Yan Li, Dongxing Zheng, Ziqiang Qiu and Xi-Xiang Zhang\*



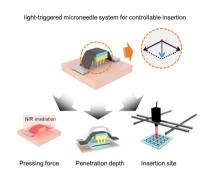




## 3044

## Microneedle system with light trigger for precise and programmable penetration

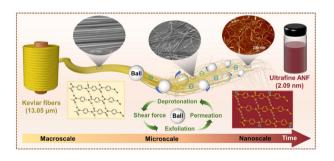
Weijiang Yu, Jieze Shen, Chong Ji, Peng Zhang, Hao Chang, Youxiang Wang\* and Jian Ji\*



## 3051

## Ultrafine aramid nanofibers prepared by high-efficiency wet ball-milling-assisted deprotonation for high-performance nanopaper

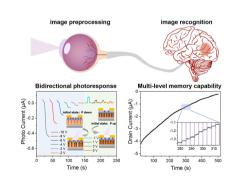
Gaojie Han, Bing Zhou, Zhaoyang Li, Yuezhan Feng,\* Chuntai Liu\* and Changyu Shen



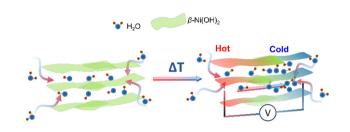
## 3061

## Integration of image preprocessing and recognition functions in an optoelectronic coupling organic ferroelectric retinomorphic neuristor

Qinyong Dai, Mengjiao Pei, Jianhang Guo, Qijing Wang, Ziqian Hao, Hengyuan Wang, Yating Li, Longfei Li, Kuakua Lu, Yang Yan, Yi Shi\* and Yun Li\*



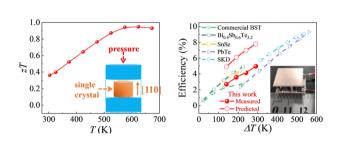
## 3072



## Application of lamellar nickel hydroxide membrane as a tunable platform for ionic thermoelectric studies

Raktim Gogoi, Arnab Ghosh, Priyamjeet Deka, K. K. R. Datta and Kalyan Raidongia\*

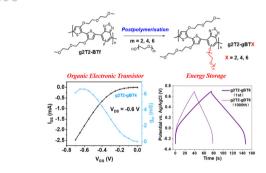
## 3082



## A boost of thermoelectric generation performance for polycrystalline InTe by texture modulation

Jianghe Feng, Menghui Zhou, Juan Li, Guoying Dong, Shufang Gao,\* Erbiao Min, Chuang Zhang, Jiaqing He,\* Rong Sun and Ruiheng Liu\*

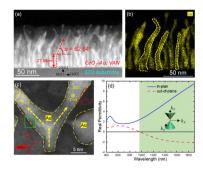
## 3090



## Tunable control of the performance of aqueous-based electrochemical devices by post-polymerization functionalization

Shengyu Cong, Junxin Chen, Bowen Ding, Liuyuan Lan, Yazhou Wang, Chaoyue Chen, Zhengke Li, Martin Heeney\* and Wan Yue\*

## 3101



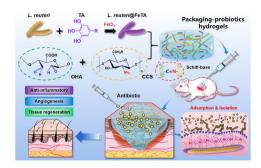
## Abnormal in-plane epitaxy and formation mechanism of vertically aligned Au nanopillars in self-assembled CeO<sub>2</sub>-Au metamaterial systems

Juanjuan Lu, Di Zhang, Robynne L. Paldi, Zihao He, Ping Lu, Julia Deitz, Ahmad Ahmad, Hongyi Dou, Xuejing Wang, Juncheng Liu, Zedong Hu, Bo Yang, Xinghang Zhang, Anter A El-Azab and Haiyan Wang\*

#### 3114

## Metal-phenolic self-assembly shielded probiotics in hydrogel reinforced wound healing with antibiotic treatment

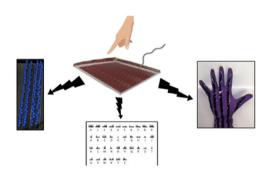
Chen Zhou, Yaping Zou, Ruiling Xu, Xiaowen Han, Zhen Xiang, Hao Guo, Xing Li, Jie Liang, Xingdong Zhang, Yujiang Fan\* and Yong Sun\*



## 3124

Flexible triboelectric nanogenerators using transparent copper nanowire electrodes: energy harvesting, sensing human activities and material recognition

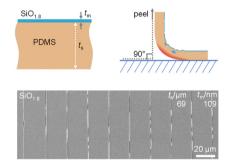
Biswajoy Bagchi, Priyankan Datta, Carmen Salvadores Fernandez, Priya Gupta, Shireen Jaufuraully, Anna L. David, Dimitrios Siassakos, Adrien Desjardins and Manish K. Tiwari\*



## 3135

#### Periodic fracture behaviour of nanomembranes

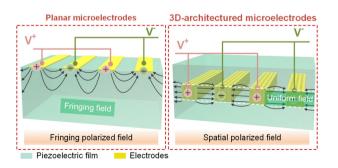
Yancheng Meng, Jiangiang Zhang, Baowen Li, Luxian Li, Qin Wang and Wanlin Guo\*



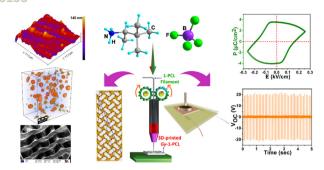
#### 3140

Electrowetting-assisted printing of 3D-architectured microelectrodes inside flexible piezoelectric films for sensitive, robust responses to bending deformation

Chao Yan, Xiangming Li,\* Zhengjie Yang, Xiaopei Wang, Hao Ran, Ruolin Zhang, Hongmiao Tian, Chunhui Wang, Xiaoliang Chen and Jinyou Shao\*



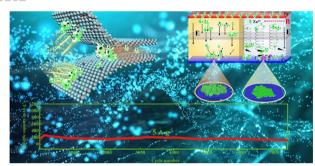
## 3153



## 3D-printed polymer composite devices based on a ferroelectric chiral ammonium salt for high-performance piezoelectric energy harvesting

Supriya Sahoo, Premkumar Anil Kothavade, Dipti R. Naphade, Arun Torris, Balu Praveenkumar, Jan K. Zaręba,\* Thomas D. Anthopoulos,\* Kadhiravan Shanmuganathan\* and Ramamoorthy Boomishankar\*

## 3162



## Magneto-electrochemistry driven ultralong-life Zn-VS<sub>2</sub> aqueous zinc-ion batteries

Yunjie Mao, Jin Bai,\* Jianguo Si,\* Hongyang Ma, Wanyun Li, Peiyao Wang, Hongli Zhang, Zhigao Sheng, Xiaoguang Zhu, Peng Tong, Xuebin Zhu, Bangchuan Zhao\* and Yuping Sun