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 14(2) 665–1346 (2026)

Cover
See Seung-Keun Park, Hee-Dae Lim *et al.*, pp. 953–961. Image reproduced by permission of Hee-Dae Lim from *J. Mater. Chem. A*, 2026, **14**, 953.

Inside cover
See Meng Huang *et al.*, pp. 936–952. Image reproduced by permission of Meng Huang from *J. Mater. Chem. A*, 2026, **14**, 936.

EDITORIAL

679

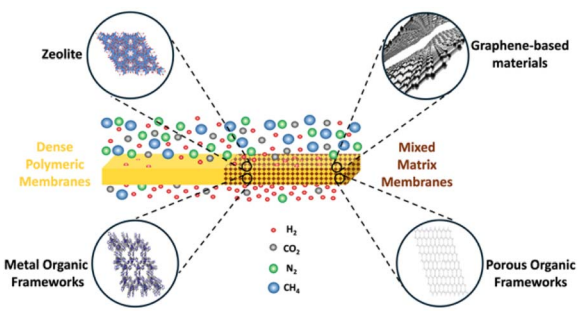
2025 *Journal of Materials Chemistry* **Lectureship winner: Dr Guanjie He**

REVIEWS

681

Mixed matrix membranes for hydrogen separation: a comprehensive review and performance analysis

Reza Sabouri, Bradley Paul Ladewig* and Nicholaus Prasetya*



ROYAL SOCIETY OF CHEMISTRY

Advance your career in science

with professional recognition that showcases your **experience, expertise and dedication**

Stand out from the crowd

Prove your commitment to attaining excellence in your field

Gain the recognition you deserve

Achieve a professional qualification that inspires confidence and trust

Unlock your career potential

Apply for our professional registers (RSci, RSciTech) or chartered status (CChem, CSci, CEnv)

Apply now

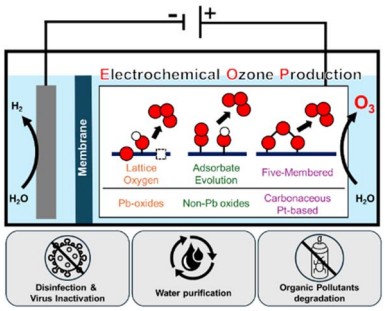
rsc.li/professional-development

REVIEWS

702

A comprehensive review of mechanism-based catalyst design and applications for electrochemical ozone production

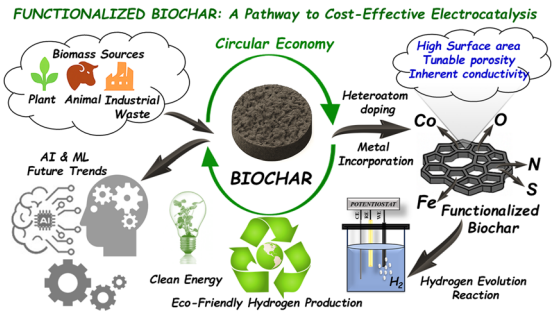
Doyeop Kim, Joyjit Kundu, Jinwon Choi, Sang-Il Choi,* Kwangyeol Lee* and Taehyun Kwon*



736

Unravelling the HER activity of functionalized biochar: a pathway to cost-effective electrocatalysis

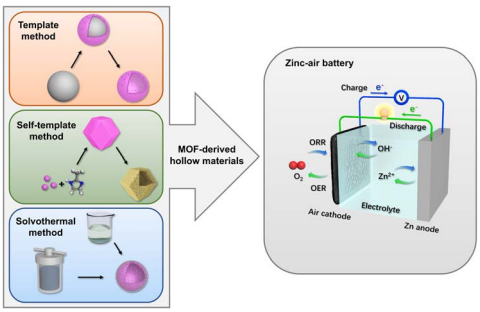
Arockia Jona Kalasan Susai, Magesh Kumar Muthukumaran, Muthukumar Govindaraj and Arockia Selvi J*



763

Metal–organic framework derived hierarchical hollow materials for high-performance zinc–air batteries

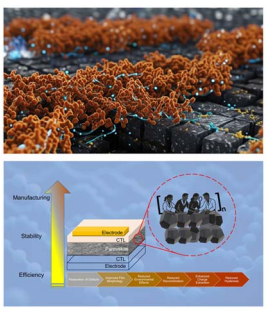
Yongji Qin, Hao Wang, Hao Zhang, Changfei Jing, Peipei Jia,* Longchao Zhuo, Xijun Liu* and Jun Luo*



783

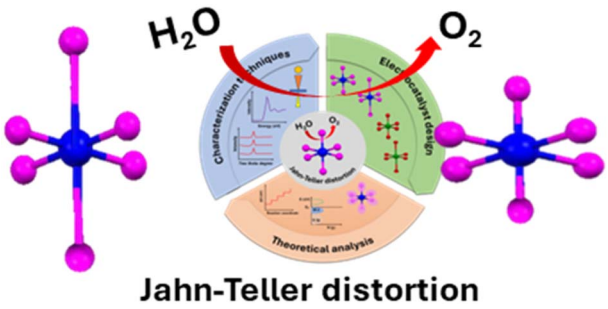
Multifunctional polymers in perovskite photovoltaics: bridging efficiency, stability, and manufacturing

Farzad Zahedi, Mohsen Ameri,* Mohammad Hossein Rajabi Manshadi, Mohammad Jafari Pouya, Marziyeh Mohebbi, Maryam Alidaei, Siming Huang, Tandis HosseinMirzaie, Galyam Sanfo and Mojtaba Abdi-Jalebi*



REVIEWS

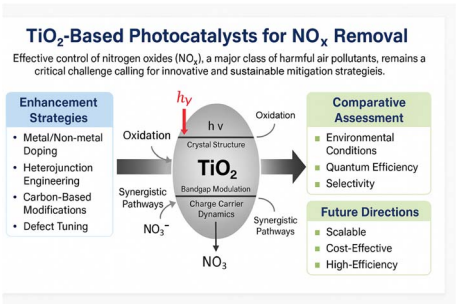
830



Jahn–Teller distortion in the oxygen evolution reaction: from fundamental insights to catalyst design

Baghendra Singh* and Apparao Draksharapu*

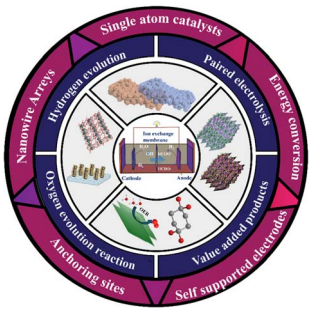
852



Engineered titanium dioxide-based photocatalysts for NO_x abatement: navigating design strategies and structure activity relationships for practical air purification

Kowsar Ahmadi, Aadil Bathla, Sherif A. Younis and Ki-Hyun Kim*

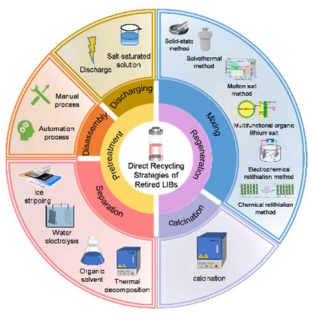
880



Paired electrolysis by regulated electronic distribution and lowering of overpotential with enhanced current density

Meemansha Mishra, Rahul Patil,* Sada Venkateswarlu, Aristides Bakandritsos, Radek Zbořil* and Saikat Dutta*

909



Recent advances in the industrialization of direct recycling for retired lithium-ion batteries

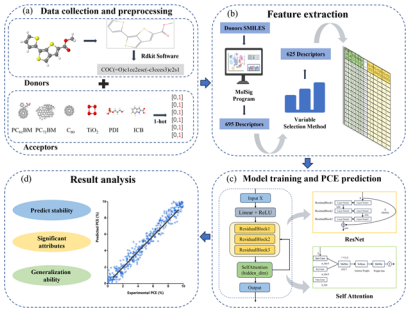
Runxin Wang, Shijie Ma, Wenze Wang,* Feng Liu,* Hongzhao Wu, Chunsheng Shi, Yanchun Ke and Biao Chen*

PAPERS

936

Accelerating the discovery of high-efficiency donor–acceptor pairs in organic photovoltaics *via* SolarPCE-Net guided screening

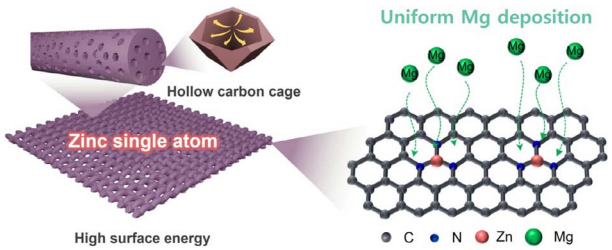
Xingyu Liu, Bo Hu, Pei Liu, Meng Huang,* Ming Li, Yuwei Wan, Bram Hoex and Tong Xie



953

Atomic-scale surface design for tailored nucleation in stable multivalent metal anodes

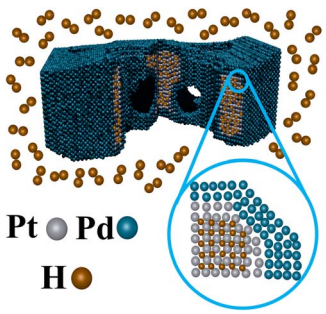
Jun-Won Lee, Jeong Ho Na, SeongJae Lee, Seonju Kim, Hee Seung Ryu, Kyeounghak Kim, Haeseong Jang, Seung-Keun Park* and Hee-Dae Lim*



962

Nanoarchitectured Pt–Pd foams as novel hydrogen reservoirs through Pt–H bonding

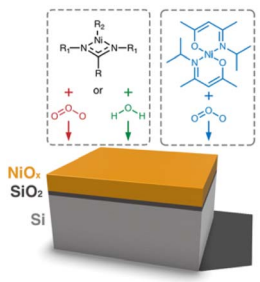
Wahidullah Khan, Alisson S. Thill, Gustavo Z. Girotto, Marco A. H. Vogt, Carlos Escudero, Fernanda Poletto, Virginia Perez-Dieste and Fabiano Bernardi*

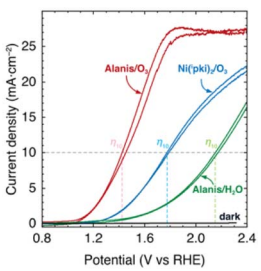


971

Atomic layer deposition of NiO_x: harnessing the potential of new precursor combinations for photoelectrochemical water oxidation

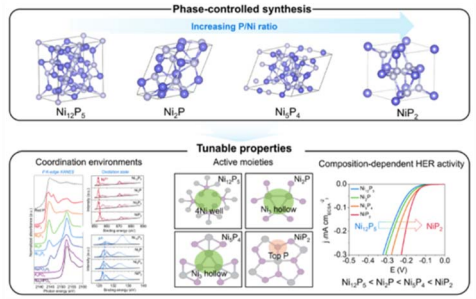
Vyshnav Kannampalli, Marcel Schmickler, Bruno Fabre, Ludovic Largeau, Antoine Seyeux, José Alvarez, Simon D. Elliott, Anjana Devi and Lionel Santinacci*





PAPERS

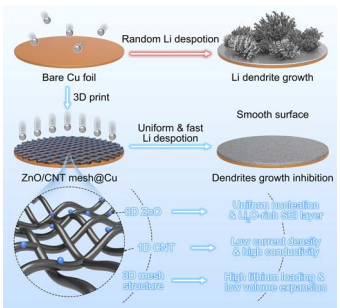
988



Colloidal phase control of Ni–P nanocrystals reveals a P-site hydrogen evolution reaction mechanism distinct from Ni-rich analogues

Yeongbin Lee, Seyoung Choi, Seohyeon Jang, Byeong-Gwan Cho, Beomgyun Jeong, Yongsam Kim, Yoonsu Park, Wooseok Jeong, Yun Jae Hwang, Hyeonseok Lee, Boeun An, Heesoo Jeong, Gyuhyeon Kim, Dong-Chen Qi, Jong Hyun Jang,* Inho Nam* and Don-Hyung Ha*

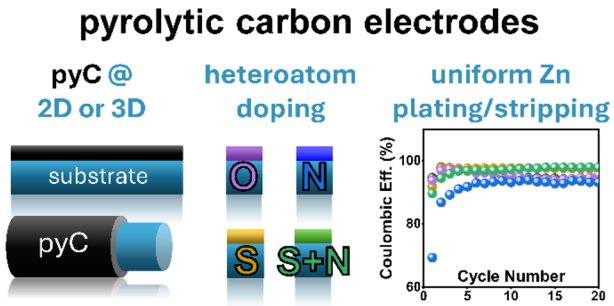
1001



A 3D-printed ZnO/CNT mesh@Cu composite electrode for dendrite-free and ultra-stable lean-lithium metal batteries

Lingtong Zhu, Shu Xu, Shaopeng Li, Yining Zhao, Wenyu Ma, Kangsheng Huang,* Hui Dou* and Xiaogang Zhang*

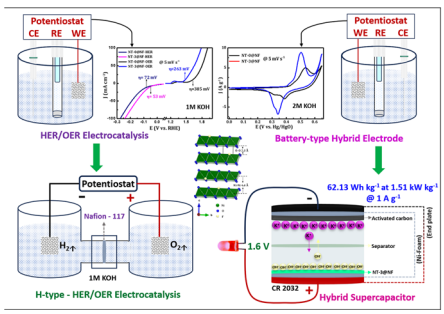
1010



Evaluating aqueous zinc electrodeposition and stripping at pyrolytic carbon electrodes with tunable surface functionality

R. Blake Nuwayhid, Hunter O. Ford, Debra R. Rolison* and Jeffrey W. Long*

1021



Fluorine-doped β-$Ni(OH)_2$–Ti_3C_2 MXene composite: a bifunctional electrode

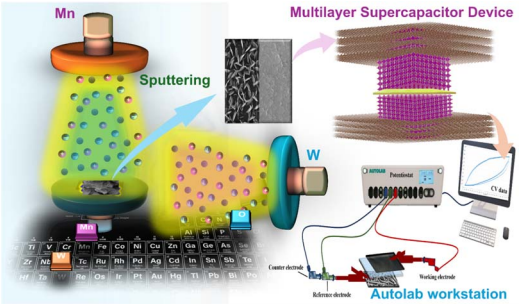
Madeshwaran Mohanraj, Moothedath Aparnasree, K. S. Rajni,* Sangaraju Shanmugam* and Mani Ulaganathan*

PAPERS

1037

Enhanced electrochemical performance of multilayer WO_3/MnO_2 thin films *via* sputtering on graphene substrate for high-stability supercapacitors

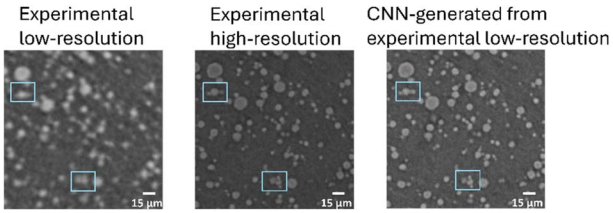
Nitesh Choudhary, Akshay Tomar, Gaurav Malik, Dushyant Chaudhary, Upendranath Nandi, Ramesh Chandra and Pradip K. Maji*



1063

X-ray imaging with AI-driven super-resolution deep learning for investigating battery electrode microstructural properties over cycling

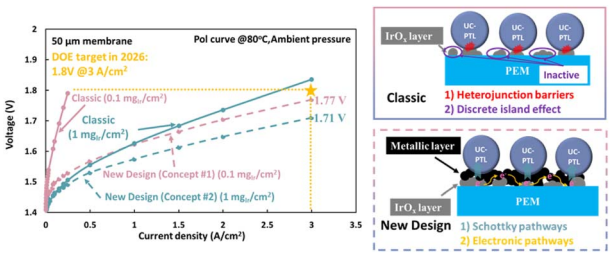
Mohammad Javad Shojaei, Guanting Li, Aditya Ramadas and Chun Huang*



1076

Simultaneously tackling discrete island effects and interfacial resistance in PEM electrolyzers *via* a scalable bilayer catalyst design

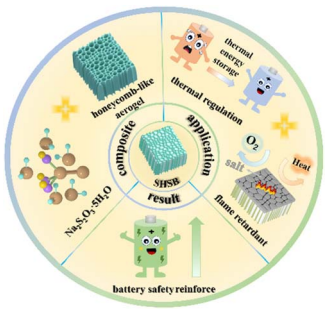
Hongjie Liao, Sandor Hollo, Zebai Chen, Zhao Zhang, Haowen Liang, Katie Pei, Luling Zhang, Ye Peng, Min Chen and Dustin Banham*



1089

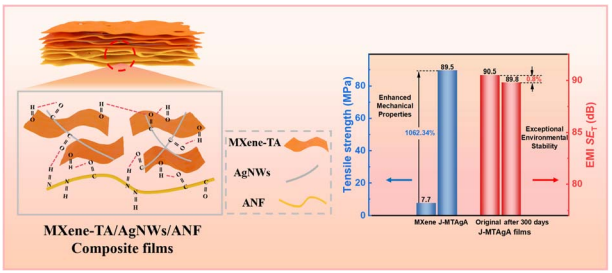
Honeycomb-like structure with excellent thermal regulation and flame-retardant functions boosts Li-ion battery safety

Beibei Lei, Ziyang Hong, Xiaoting Shen, Shanzhu Jiang and Miao Wang*



PAPERS

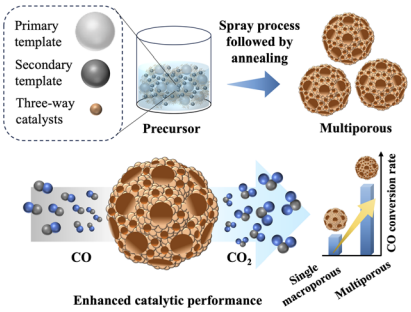
1098



Janus-structured MXene composite films with tannic acid-enhanced strength and environmentally stable electromagnetic interference shielding

Fan Xie,* Yuxuan Shang, Qiaoling Liu, Haitao Wei, Tao Liu, Yueyue Zhao, Wenting Zhang, Longhai Zhuo* and Zhaoqing Lu*

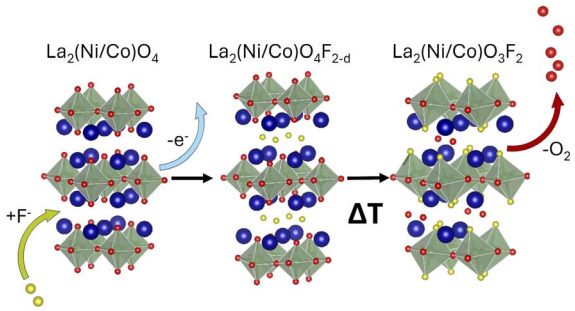
1110



Multiporous structure formation in three-way catalyst particles for enhanced catalytic performance

Duhaul Biqal Kautsar, Phong Hoai Le, Kosuke Kondo, Kiet Le Anh Cao, Eka Lutfi Septiani, Tomoyuki Hirano and Takashi Ogi*

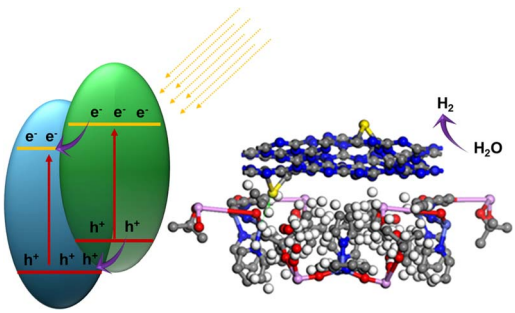
1123



Gas evolution in Ruddlesden–Popper-type intercalation cathodes in all-solid-state fluoride-ion-batteries: implications on battery performance and synthesis of highly oxidized oxyfluorides

Tommi Hendrik Aalto, Jonas Jacobs, Felix Frey, Dörthe Schiewe and Oliver Clemens*

1136



A sulfoxide-functionalized graphitic carbon nitride–cobalt dialkyl phosphate bipyridine heterojunction for photocatalytic hydrogen production

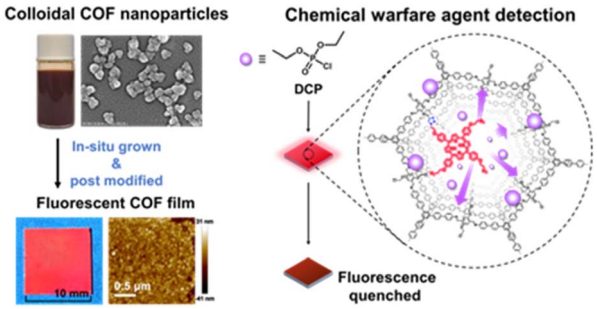
Navneet Matharoo, Mohammed Fawaz, Nithinraj Panangattu Dharmarajan, Ayona K. Jose, Jae-Hun Yang, Matej Huš, C. I. Sathish, Xuan Minh Chau Ta, Harleen Kaur, Yuwei Wang, Antonio Tricoli, Prashant Kumar, Blaž Likozar, Ramaswamy Murugavel* and Ajayan Vinu*

PAPERS

1149

Thermal alkyne–azide cycloaddition enables the fabrication of fluorescent COF thin films for sensitive chemical warfare agent sensing

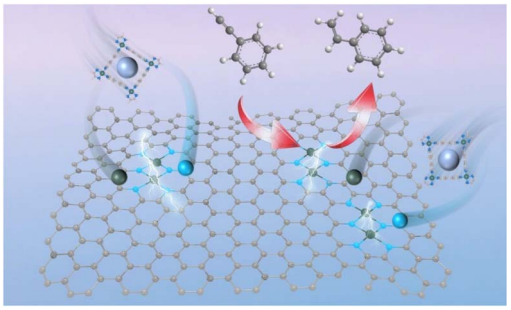
Weiqi Zhang, Kongqing Zhang, Qing Bai, Xiangyu Zhang, Ying Wang, Cheng Zhou, Hongwei Song, Hongwei Ma* and Liang Yao*



1159

Rational synthesis of Pd dual-atom catalysts *via* molecular precursor engineering for selective hydrogenation

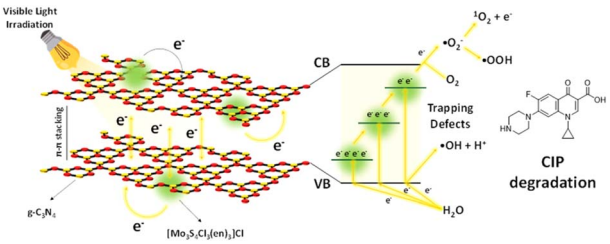
Kai Zhang, Chunyi Yu, Shang Han, Yang Wang, Yang Liu, Zhi-Wei Xing, Lifeng Ding* and Lin-Bing Sun*



1167

Electron trap engineering in g-C_3N_4 with molecular Mo_3S_4 clusters for visible-light-driven photocatalysis

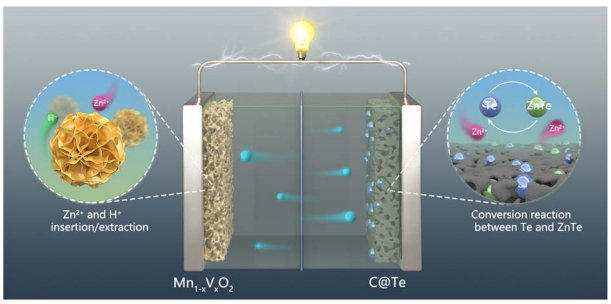
Mayra Luiza Gonçalves Rodrigues, Juanjo Mateu-Campos, Anelisse Brunca Silva, Maria Gutiérrez-Blanco, José Balena Gabriel Filho, Caue Ribeiro, Rosa Llusar, Juan Andrés, Elson Longo and Marcelo Assis*



1183

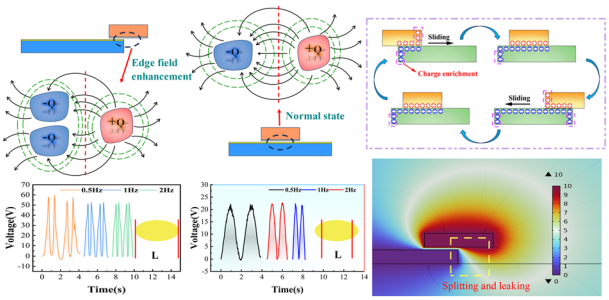
Lattice engineering in MnO_2 *via* V^{5+} doping for high-performance aqueous Te–MnO_2 batteries

Xinyang Zhang, Xiaoyu Yang, Yingjun Wei, Dewei Wang* and Yuhong Chen



PAPERS

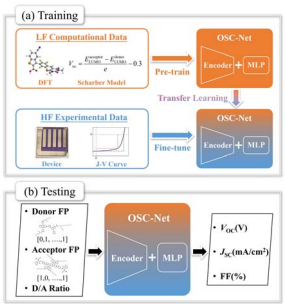
1195



On the electrostatic boundary effect: key influencing factors and underlying mechanisms in patterned triboelectric sensors

Tenghong Su, Xiao Lei, Dongdong Suo, Jijie Ma, Yili Hu, Jianping Li, Yingting Wang,* Ya Li* and Jianming Wen*

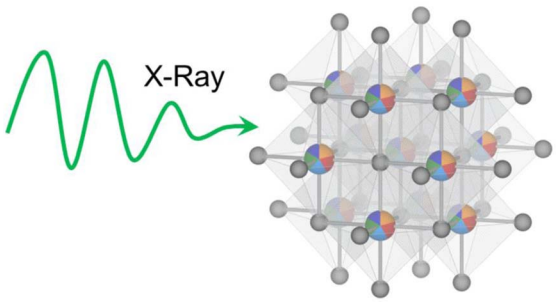
1208



OSC-Net: a multi-fidelity machine learning model for organic solar cells

Haizhou Yang, Adam Wold, Junlin Ou, Jeromy J. Rech, Wei You* and Yi Wang*

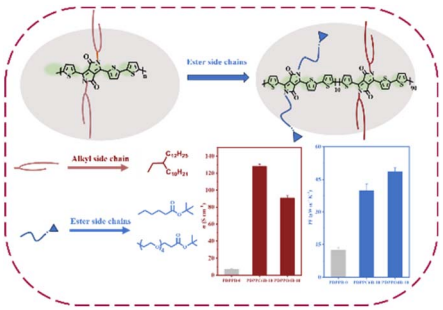
1221



X-ray analysis of $Mg_{0.2}Co_{0.2}Ni_{0.2}Cu_{0.2}Zn_{0.2}O$: disentangling elemental contributions in a prototypical high-entropy oxide

Maryia Zinouyeva,* Martina Fracchia, Giulia Maranini, Mauro Coduri, Davide Impelluso, Nicholas B. Brookes, Lorenzo Grilli, Kurt Kummer, Francesco Rosa, Matteo Aramini, Giacomo Ghiringhelli, Paolo Ghigna and Marco Moretti Sala*

1234



Synergistic regulation of ester side chains and thermal annealing to enhance electrical conductivity in diketopyrrolopyrrole-based conjugated polymers for thermoelectric generation

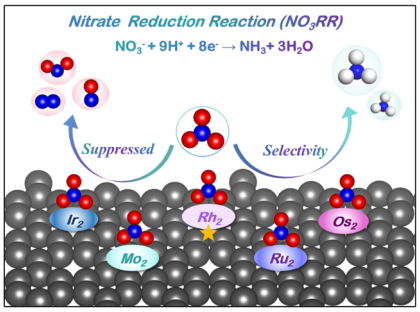
Zhiyong Luo, Guoliang He, Fei Zhong, Xuewen Xie, Mingliang Wang, Linhai Jiang, Chunmei Gao* and Lei Wang

PAPERS

1245

Design principles of biphenylene-supported dual-atom catalysts for efficient and selective nitrate reduction to ammonia

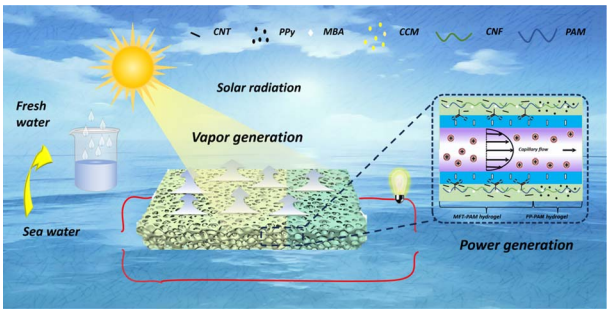
Kiruthika Pandiyan and Hsin-Tsung Chen*



1260

Preparation of gradient heterogeneous hydrogels by Pickering emulsion templating method and its trifunctional coupling of photothermal–evaporation–power generation

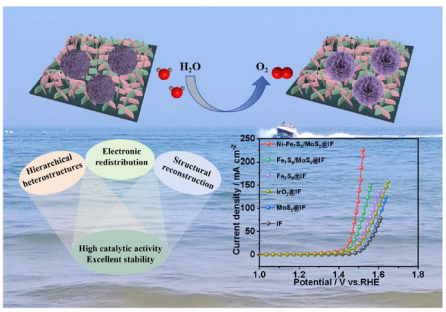
Lu Chen, Qiao You, Min Ling, Qingwu Jiang, Anyun Li, Liyue Qin, Shizhe Ma, Chunlin Feng,* Yunhua Chen,* Chaoyang Wang and Hongxia Liu*



1274

Hierarchical Ni-doped Fe_7S_8/MoS_2 heterostructures: enhanced oxygen evolution reaction *via* electronic redistribution and structural reconstruction

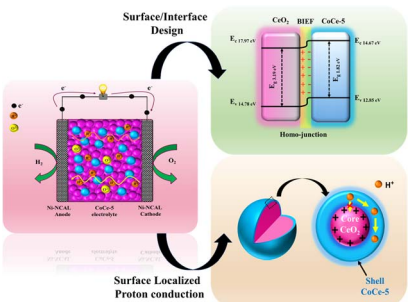
Zhe Feng, Kaiyu Liu, Shaoshuang Zhu, Huimin Jiang and Jianjian Lin*



1285

Mechanistic insights into superionic conduction *via* homo-interface design for next generation semiconductor ionic fuel cells

Sarfraz, Shahzad Rasool, Nabeela Akbar, Badriah S. Almutairi, Muhammad Shahid Sharif, Muhammad Khalid, M. A. K. Yousaf Shah, Touseef Ahmad, Naveed Mushtaq,* Yuzheng Lu* and Bin Zhu*



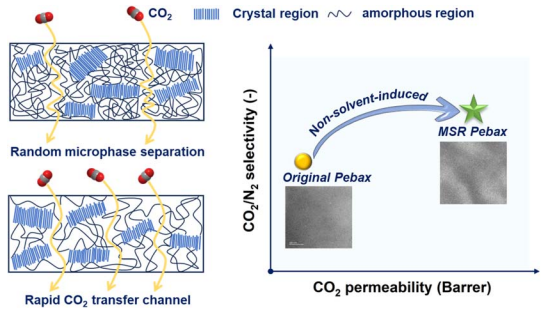
PAPERS

1301

Water-based room-temperature synthesis of Ce-BDC-MOFs using different additives: a comprehensive investigation on properties and tetracycline adsorption performance

Hossein Molavi* and Somayeh Saeedi

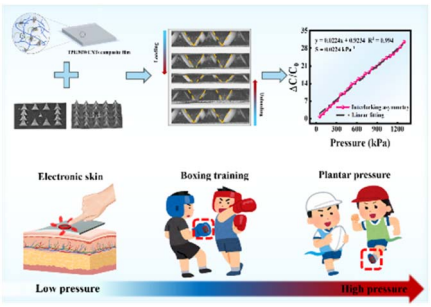
1319



Non-solvent-induced microstructure rearrangement for significantly enhanced CO_2/N_2 separation performance of Pebax 2533 membranes

Jing Wei, Min Deng, Yun Li, Long Shi, Zikang Qin, Junfeng Zheng,* Lin Yang, Lu Yao, Wenju Jiang and Zhongde Dai*

1331



High-*k* elastic composite dielectrics and microstructural engineering: high-sensitivity, ultra-wide linear range, and robust flexible capacitive pressure sensors for wearable electronics

Huiqi Zhang, Yu Xu, Miao Miao, Mingwei Han, Li Zhang, Xianzhe Liu,* Hongan Cai, Weijiang Liang, Jingxiang Yang, Guoning Chen, Jinxiu Wen, Aiping Huang,* Bingpu Zhou* and Jianyi Luo*

CORRECTION

1343

Correction: Tracking phase transformations in $LiMn_{1.5+x}Ni_{0.5-x}O_4$ by high resolution X-ray diffraction

Halvor Høen Hval* and Helmer Fjellvåg*