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Journal of Materials Chemistry A

Materials for energy and sustainability

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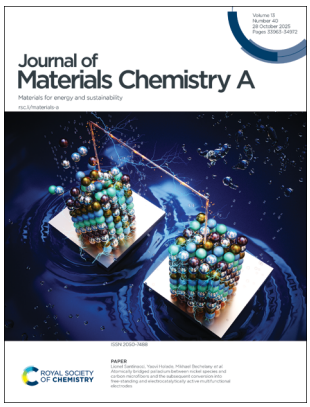
IN THIS ISSUE

ISSN 2050-7488 CODEN JMCAET 13(40) 33963–34972 (2025)



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See Kumasser Kusse Kuchayita and Chih-Chia Cheng, pp. 34249–34259. Image reproduced by permission of Chih-Chia Cheng from *J. Mater. Chem. A*, 2025, **13**, 34249.

EDITORIAL

33985

Nanogenerators as a fundamental of a sustainable and intelligent energy future

Zhong Lin Wang,* Pooi See Lee* and Ya Yang*

PROFILE

33988

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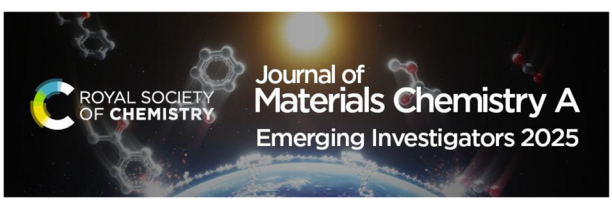

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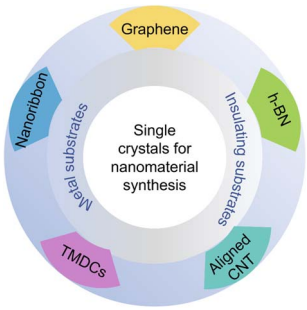
REVIEWS

34014

The role of single-crystal substrates in synthesis of low-dimensional materials by CVD and their applications in electrocatalysis

Li Li, Jiaqi Chen* and Tao Sun*



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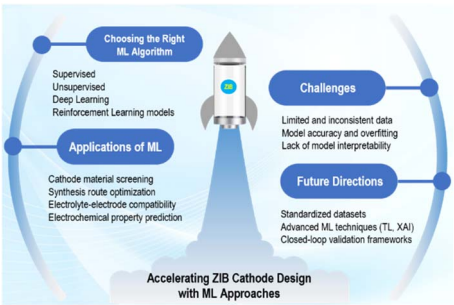
From atoms to algorithms: a review of machine learning approaches to cathode material innovation in zinc-ion batteries

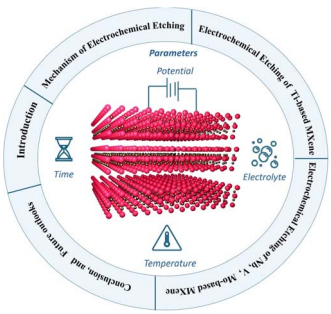
Jenitha Moses and Ajay Rakkesh Rajendran*



34055

Electrochemical etching of MXenes: mechanism, challenges and future outlooks

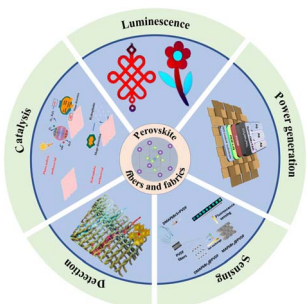
Shaista Nouseen and Martin Pumera*



34085

Advances in perovskite-based functional fibers and fabrics: toward smart, sustainable, and wearable technologies

Long Zhang, Zijun Yi* and Xuehong Ren*



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REVIEWS

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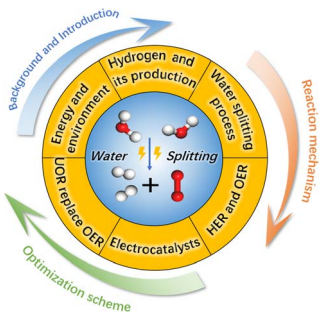

Advancements in water electrolysis: enhancing hydrogen and oxygen production efficiency through electrocatalyst design and urea oxidation

Xuze Tang, Yuemin Xin, Renhong Chen, Xuefeng Ren,* Liguo Gao, Hao Xu,* Peixia Yang and Anmin Liu*

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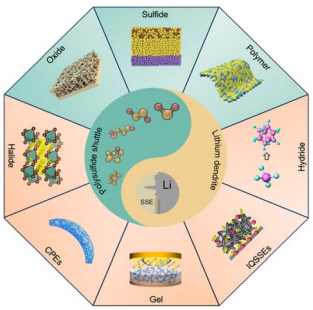
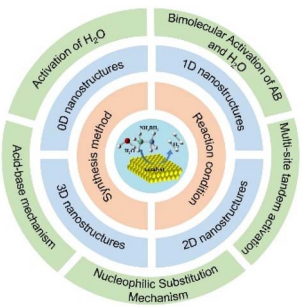


Taming polysulfide shuttle and lithium dendrites in lithium–sulfur batteries *via* all-/quasi-solid-state electrolytes: recent progress and future prospects

Chuju Wang, Hao Tan, Xiaozhen Li, Zishun Lin, Jing Xu, Tao Mei, Xianbao Wang,* Guoxiu Wang* and Yi Chen*

34185



Research progress of heterogeneous catalysts with different dimensional supports for catalytic hydrolysis of ammonia borane

Chengming Wang, Hao Ma, Shuling Liu, Ning Duan, Huanhuan Zhang, Zhuoyao Wang, Wei Lv, Xingyuan Fu, Yanyan Liu and Baojun Li*

COMMUNICATION

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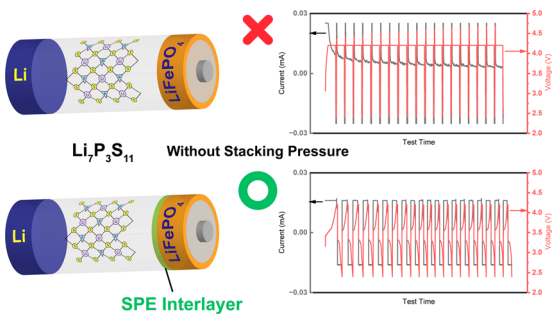

Synergy of metal halide doping and a polymeric interface enables improved electrochemical performance of all solid-state Li batteries

Madan Bahadur Saud, M. Bilal Faheem, Hansheng Li, Haining Zhang, Bilawal Khan, Samprash Risal, Abiral Baniya, Xinlu Wang, Yuchen Zhang, Ruosi Qiao, Poojan Kaswekar, Ian Dean Hosein, Yeqing Wang, Jr-Hau He, Zheng Fan and Quinn Qiao*

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PAPERS

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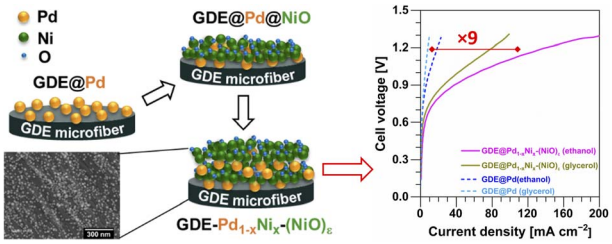
Atomically bridged palladium between nickel species and carbon microfibers and the subsequent conversion into free-standing and electrocatalytically active multifunctional electrodes

Zahra Hagheh Kavousi, Clémence Badie, Vyshnav Kannampalli, Massomeh Ghorbanloo, Qing Wang, Hazar Guesmi, Lionel Santinacci,* Yaovi Holade* and Mikhael Bechelany*



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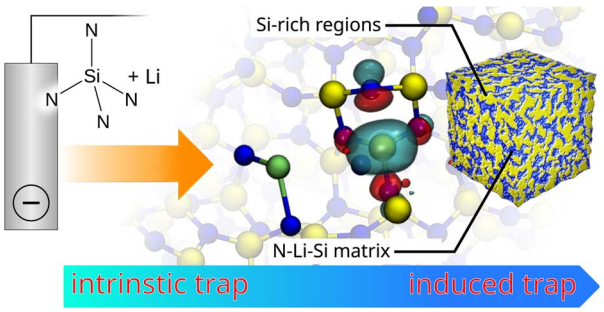
Robust P–N heterojunction polymer nanocomposites: advanced pH-universal electrocatalysts for highly efficient and stable water-splitting hydrogen production

Kumasser Kusse Kuchayita and Chih-Chia Cheng*

34260

Forged by charge: polaron-induced matrix formation in silicon nitride conversion-type anodes for lithium-ion batteries

Jonathon Cottom, Lukas Hückmann, Jörg Meyer and Emilia Olsson*



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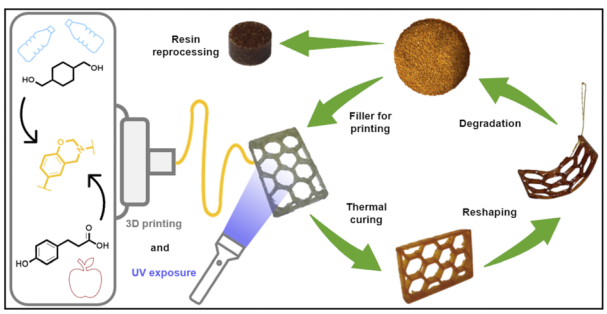
A recyclable, reshapable and UV-curable polybenzoxazine vitrimer enabling closed-loop 3D printing applications

Charles Jehl, Antoine Adjaoud, Ambre Meyer, Vincent Boulic, Channya Hesse, Laura Puchot, Joamin Gonzalez-Gutierrez, Alexander S. Shaplov, Daniel F. Schmidt and Pierre Verge*



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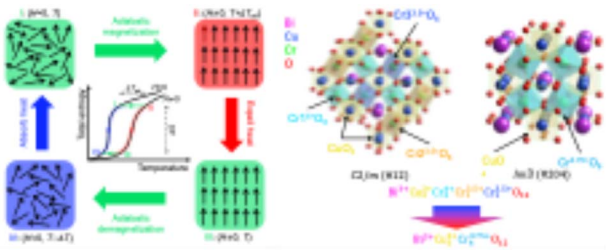
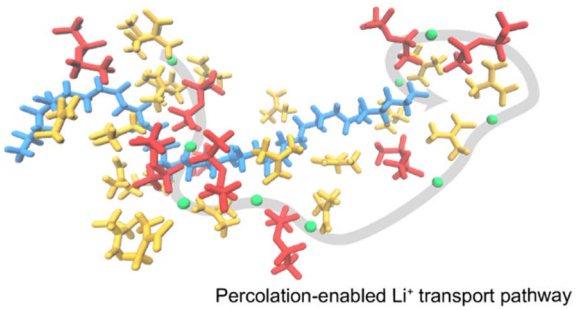


Insights into the giant magnetocaloric effect in $BiCu_3Cr_4O_{12}$ with charge–spin–lattice coupling

Hung Ba Tran,* Hao Li,* Masato Goto, Kazunori Sato and Yuichi Shimakawa

34297



Percolation-enabled long-range ion transport to achieve conductivity leap in PVDF-based electrolytes

Lingjie Luo, Han Lin, Rui Wu, Zengyao Zhang, Qiyun Li, Yuxuan Liu,* Jun Liu, Renzong Hu* and Min Zhu

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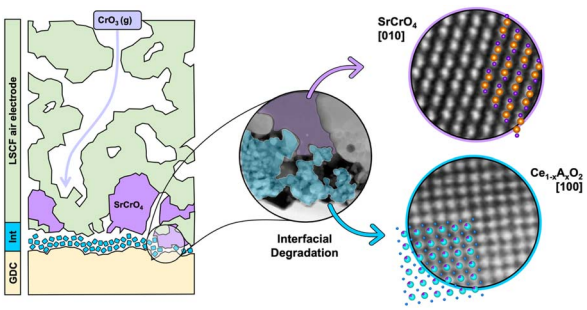
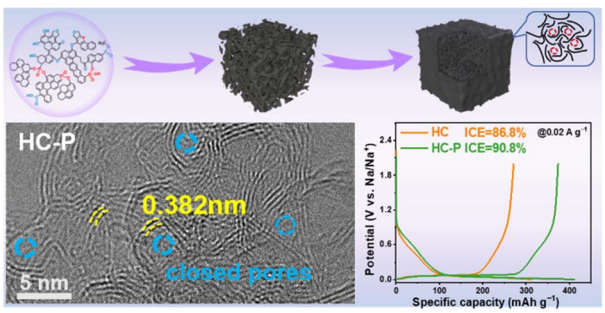


Atomic-scale insights into air electrode degradation after 10 years of fuel cell stack operation

Moritz Kindelmann,* Olivier Guillon, Joachim Mayer and Norbert H. Menzler

34316



Stepwise crosslinking–activation to create a closed pore structure of hard carbon for boosted sodium energy

Jianfang Wang, Yaxin Huang, Weijia He, Yongli Li, Ting Ma, Chunguang Wei,* Jian-Gan Wang* and Ding Nan*

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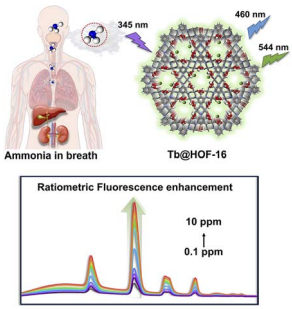
Lanthanide ion-sensitized hydrogen-bonded organic framework as a fluorescent sensing platform for ultra-low concentration breath ammonia detection

Yuxin Wang, Jing Wang, Chao Zhi, Xueqiang Guo, Lifei Yin, Changxiao Li, Jinping Li, Libo Li,* Lixia Ling* and Jia Yao*



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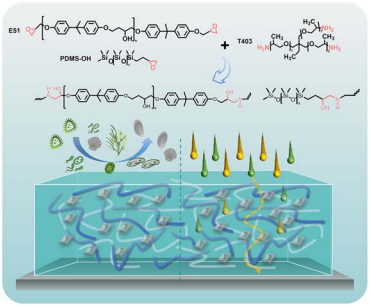
Construction of a photothermal self-healing epoxy coating with anti-fouling and anti-corrosion functions inspired by the hierarchical surface morphology of starfish

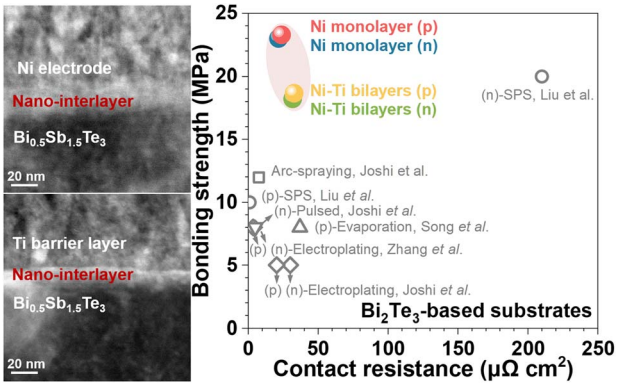
Ming-Yang Zhang, Yong-Yin Cui, Hong-Wei Cheng, Jia-Yuan Chen, Ke-Yu Wang, Ting-Yu Zhang, Hui-Jing Li and Yan-Chao Wu*



34346

***In situ* formed nano-interlayer enables robust interface bonding in efficient Bi_2Te_3-based thermoelectric modules**

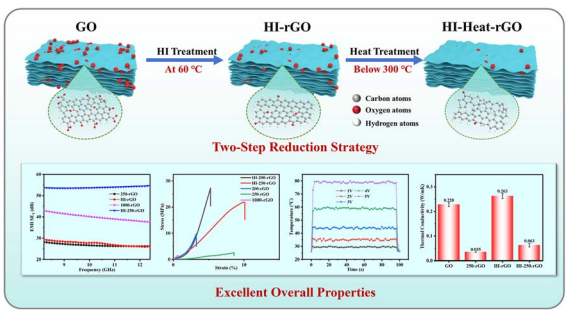
Rui Zhou, Ziyan Li, Shujing Yang, Xuemei Wang, Xinyi Shen, Long Yang, Zhiwei Chen, Juan Chen* and Wen Li*



34353

Fabrication of reduced graphene oxide electromagnetic shielding films with excellent comprehensive performance using a two-step reduction strategy

Yufan Wu, Wenhao Liang, Juntao Wu,* Shan Zhang, Yun-Tian Chen, Jiahui Yan, Chengyuan Shang, Xiaobiao Zuo* and Guang-Sheng Wang*



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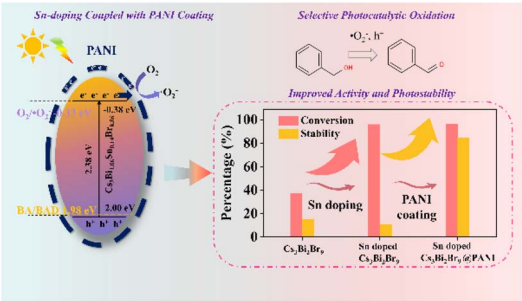
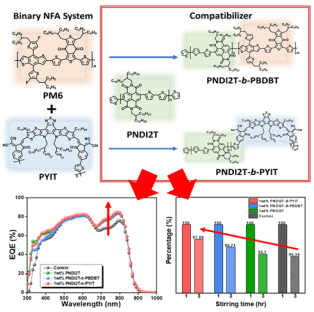


Dual-functional engineering of Sn-doping and polyaniline coating for $Cs_3Bi_2Br_9$ perovskite: boosting its photocatalytic activity and photostability in selective oxidation of benzyl alcohol

Hao Li, Hongxia Yang, Baozhu Tian* and Jinlong Zhang*

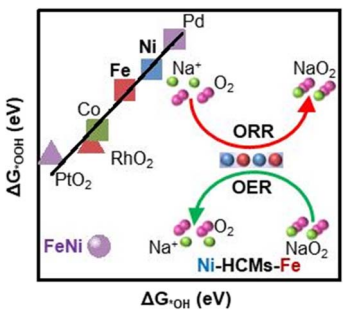
34375



Tailoring block copolymer-type compatibilizers to enhance the performance and processability of inverted all-polymer solar cells

Hsu-Tzu Cheng, Aoto Kato, Yu-Cheng Tseng, Cheng-Yu Yeh, Hao-Wei Yu, Tomoya Higashihara* and Chu-Chen Chueh*

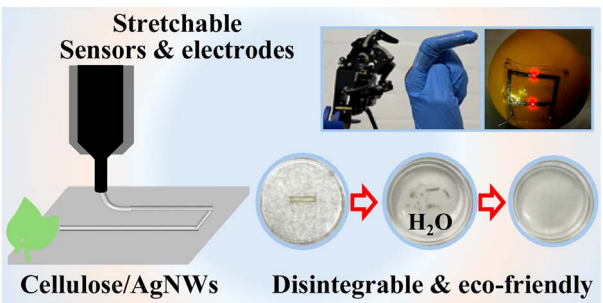
34384



Breaking scaling relations *via* Fe/Ni diatomic catalysts towards highly efficient electrocatalysts for rechargeable Na-air batteries

Wenwen Yin, Jiawei Ma, Yanyan Li, Qing Cheng, Bernt Johannessen,* Fangxi Xie* and Mingmei Wu*

34393



Eco-friendly, flexible and stretchable printed electronics based on a sustainable elastic substrate and ink

Danish Tahir, Xuan Li, Milad Razbin, Krish Singh, Anil R. Ravindran, Shuhua Peng and Shuying Wu*

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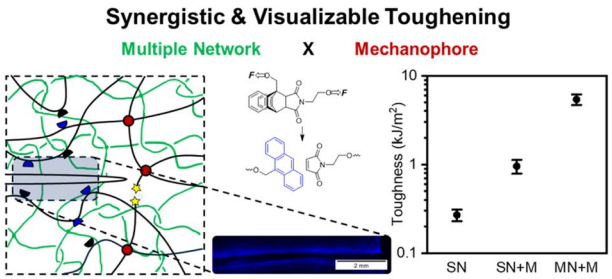
Synergistic and visualized toughening of elastomers through mechanophore crosslinks and multiple networks

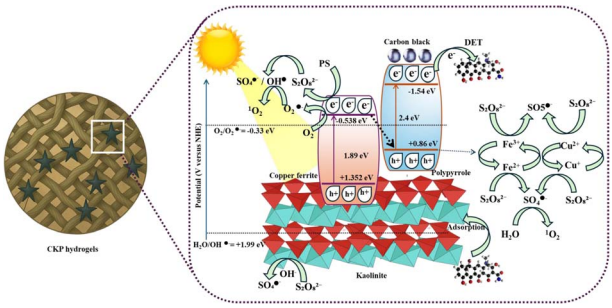
Zeyu Wang, Yongming Wang, Ming-Chi Wang, Zehao Fan and Junpeng Wang*



34417

Engineered 3D copper ferrite/kaolinite/polypyrrole carbon black hydrogels for efficient persulfate activation in tetracycline degradation: kinetics, mechanistic insights, toxicity, and green metrics

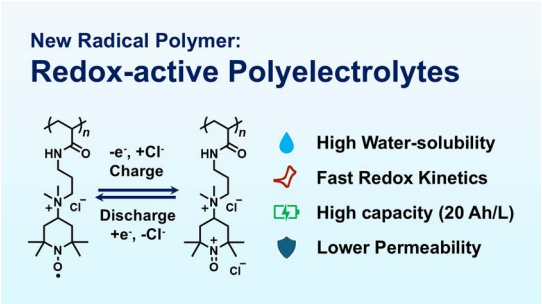
Akash Balakrishnan,* Tushar Kumar Khora, Khwairakpam Bidya Devi, Mahendra Chinthala, Arvind Kumar and Natarajan Rajamohan*



34440

Combining low viscosity and high volumetric redox density of organic polymers for energy-efficient catholytes in redox flow batteries: a redox-active polyelectrolyte approach

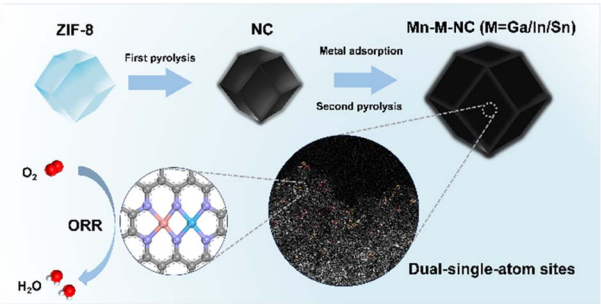
Kohei Ishigami and Kenichi Oyaizu*



34447

Synthesis of MnM–NC (M = Ga, In, Sn) dual-single-atom catalysts for efficient electrocatalytic oxygen reduction

Yujie Cui, Yihong Liu, Jiayi Li, Haibin Ma, Tingting Pan, Hainan Wei, Xinyue Shi, Xiaoyan Zhou, Ping Zhang, Weixing Niu, Shengnan Sun, Menghao Yang, Wei-Hsiang Huang,* Jiwei Ma and Hongfei Cheng*



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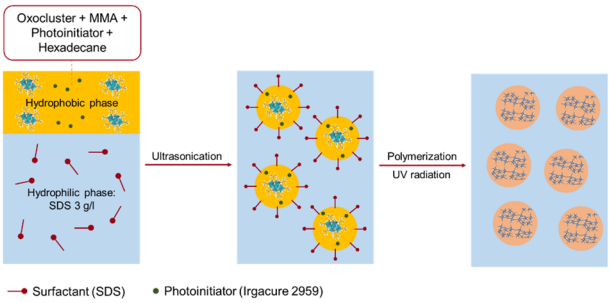
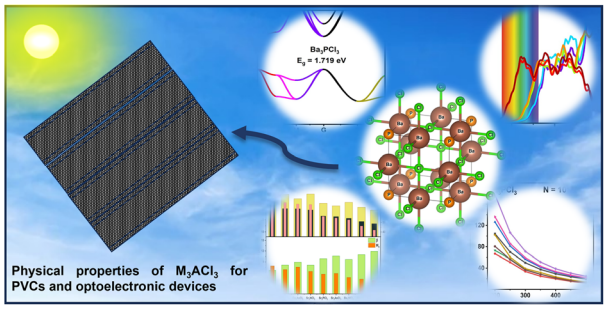


Confined-space synthesis of Zr-, Ti-, and Ti–Zr-oxocluster-based hybrid nanoparticles as catalysts for H_2O_2-mediated oxidations

Davide Vendrame, Giulia Bragaggia, Alessandro Dolmella, Giacomo Saielli, Mauro Carraro* and Silvia Gross*

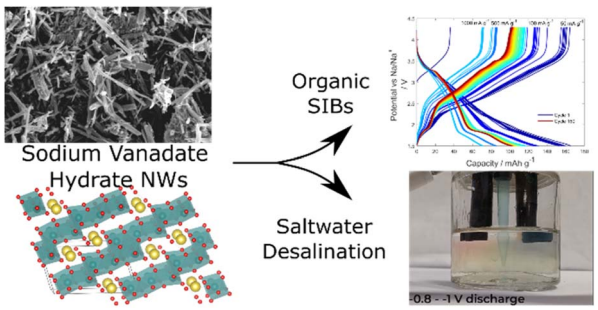
34469



Inorganic M_3ACl_3 (M = Ca, Sr, Ba, A = N, P, As) perovskite-derivatives for next-generation solar cells and optoelectronics: in-depth analysis of stability, optoelectronic features, and temperature-dependent carrier mobilities

Zia Ur Rehman* and Zijing Lin*

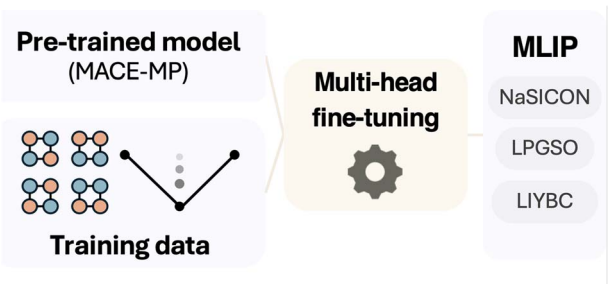
34493



Nanostructured sodium vanadate hydrate as a versatile sodium ion cathode material for use in organic media and for aqueous desalination

Daniel Commandeur,* Vlad Stolojan, Monica Felipe-Sotelo, James Wright, David Watson and Robert C. T. Slade

34507



Accelerating the discovery of disordered multi-component solid-state electrolytes using machine learning interatomic potentials

Yanhao Deng, Yan Li, Gopalakrishnan Sai Gautam, Bonan Zhu* and Zeyu Deng*

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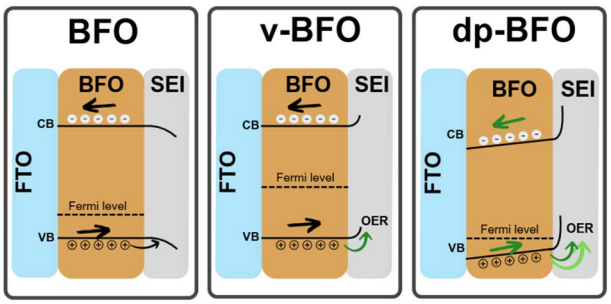
Inducing n-type photoanodic behavior in p-type bismuth ferrite *via* ferroelectric polarization

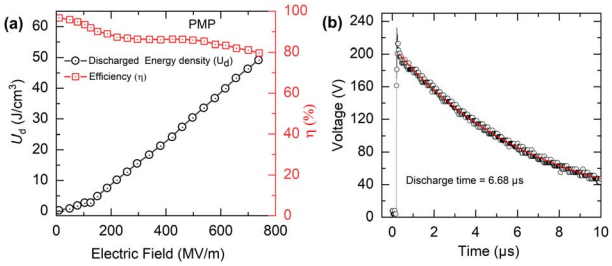
Michael Gunawan, Yimeng Jin, Teng Chi Leung, Owen Bowdler, Shujie Zhou, Denny Gunawan, Ming Zhang, Xueqing Fang, Qi Zhang, Nagarajan Valanoor, Rose Amal, Judy N. Hart,* Jason Scott* and Cui Ying Toe*



34530

High-density electrostatic energy storage in a multi-layer P(VDF-TrFE-CFE)/2D mica nanocomposite heterostructure capacitor

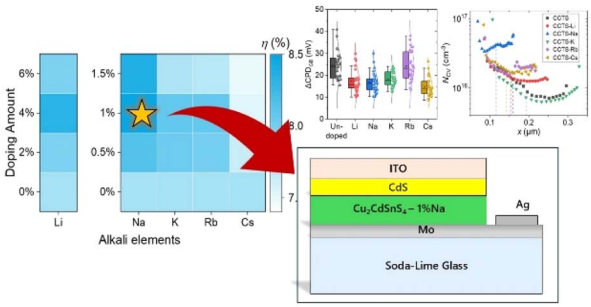
Rohit R. Srivastava, Roshan Padhan, Sumit Bera, Pallavi B. Jagdale, Novuhulu Rhakho, Rahul Rao, Anirudha V. Sumant and Nihar R. Pradhan*



34540

The role of alkali doping in enhancing bulk and interface properties of Cu_2CdSnS_4 solar cells

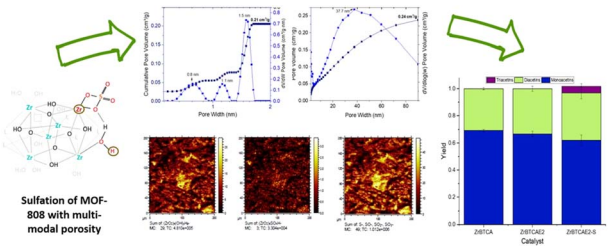
Edwin Julianto, Ha Kyung Park, Ahmad Ibrahim, Stener Lie, You Jung Choi, Geumha Lim, Mufti Ali Ar-Royan, Anupam Sadhu, Akhmad Herman Yuwono, William Jo and Lydia Helena Wong*



34550

Ordered multi-modal sulfated MOF-808 and its improved catalytic performance in glycerol esterification

Carolina Ardila-Suárez,* Iván M. Mora-Vergara, Cesar A. Bravo-Sanabria, Gustavo E. Ramírez-Caballero and Víctor G. Baldovino-Medrano*



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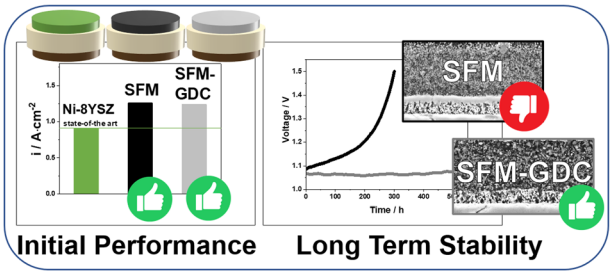
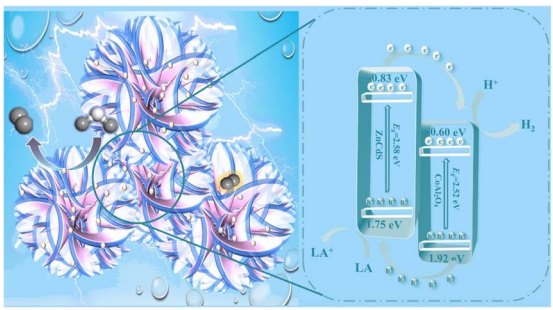
34565



Electrochemical performance and durability of high-temperature solid oxide electrolysis cells with SFM and SFM-GDC fuel electrodes for hydrogen and syngas production

Stephanie E. Wolf, Vaibhav Vibhu,* Pritam K. Chakraborty, Carla L. Coll, Sandro Schöner, Shibabrata Basak, Izaak C. Vinke, L. G. J. (Bert) de Haart and Rüdiger-A. Eichel

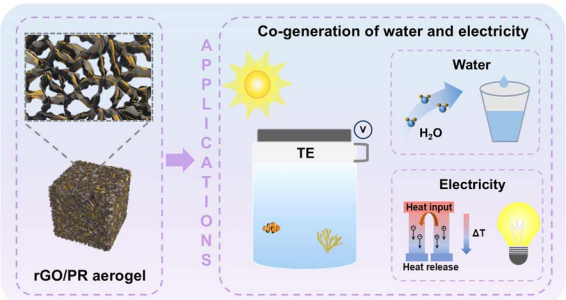
34585



Charge separation engineering *via* $CoAl_2O_4$/ZnCdS heterojunction and d-band center modulation for synergistically enhanced photocatalytic hydrogen evolution

Shuai Wang, Yihu Ke,* Fei Jin and Zhiliang Jin*

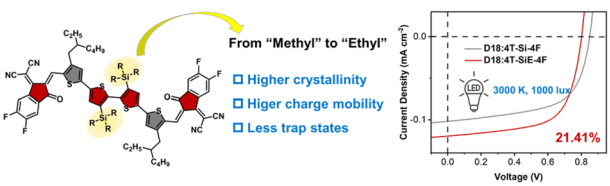
34599



A robust and stable phenolic resin-crosslinked graphene aerogel for efficient solar-driven steam-power co-generation

Chuchu Zhang, Jiapeng Song, Yanjun Li, Jiaqi Chen, Zhuoli Yang, Yuanjin Wang, Tao Liu, Long Chen, Zhenggang Rao* and Linfeng Fei*

34609



Fully non-fused acceptors with alkylsilyl side-chains for efficient indoor organic photovoltaics

Yao Wu, Fang Wang, Junhong Liang, Ruize Zhou, Xiang Gao,* Jinsheng Song,* Jianhong Gao, Hui Chen and Zhitian Liu*

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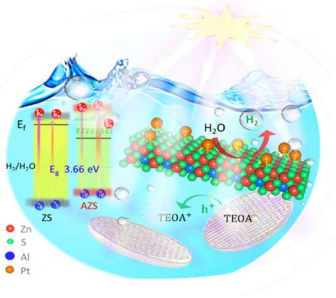
34615

Development of single crystalline Al-doped ZnS nanodiscs as efficient photocatalysts for H_2 evolution reaction

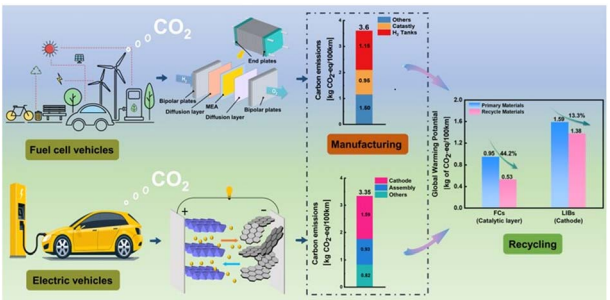
Rohit R. Koli, I.-Hua Tsai, Yu-Bin Huang, Chia-Hsin Wang, Bo-Hong Liu, Raghunath Putikam, M. C. Lin and Eric Wei-Guang Diau*



34626

Comparison of life cycle assessment in the fuel cell industry chain and the lithium battery industry

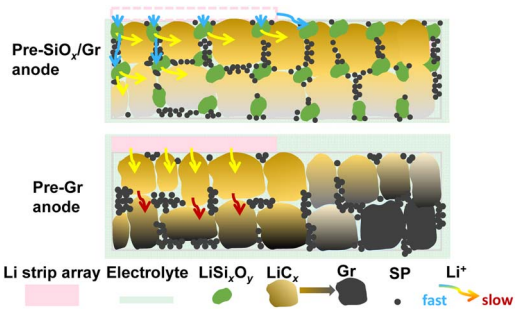
Wenjie Zhang, Jiawei Wen, Xin Wang, Xiaoming Zhang, Bin Wu, Wenhao Yu, Fengshan Yu, Rong Yi, Xiao Lin* and Guoyong Huang*



34640

SiO_x enhances prelithiation kinetics and homogeneity in graphite-based anodes

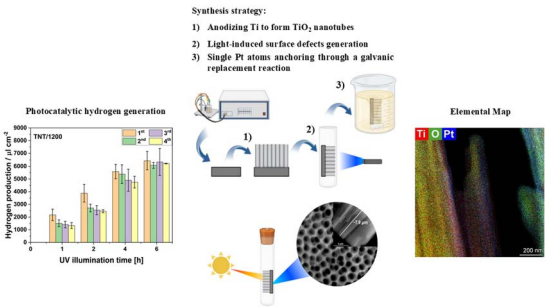
Wenting Luo, Qitao Shi, Can Zhang, Ruowei Yi, Wenlong Zhao, Yingdan Cui, Yanbin Shen, Jun Ge,* Chao Wang* and Yunhui Huang*



34648

Light-induced surface defects in anodic TiO_2 nanotubes as trapping centers for single Pt atoms, a co-catalyst for enhanced photocatalytic hydrogen evolution

Ewelina Szaniawska-Białas,* Thorsten Schultz, Amanda Opis-Basilio, Dariusz Zasada, Norbert Koch, Kallol Ray, Nicola Pinna and Ewa Wierzbicka*



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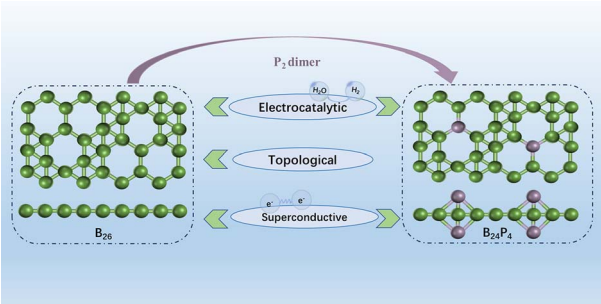
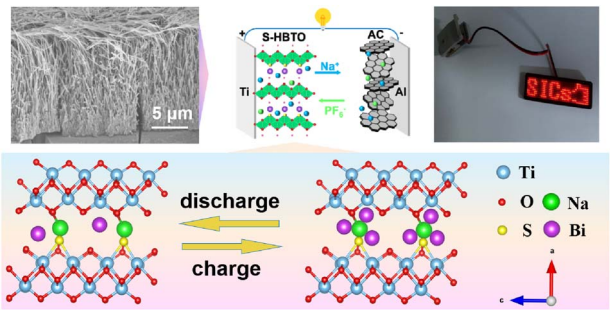


A cluster-assembled B_{26} monolayer and its inverse-sandwiched derivative $B_{24}P_4$: stable 2D boron-based materials with topological properties, superconductivity, and electrocatalytic activity

Rong Liu, Bing Han, Fengyu Li* and Zhongfang Chen*

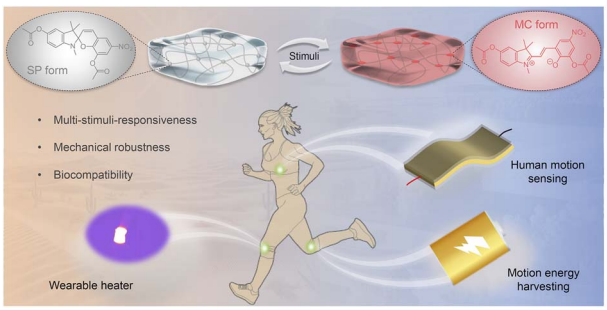
34671



Fast sodium storage kinetics of titanate-based anode materials *via* Bi^{3+}/S co-doping engineering for advanced sodium-ion capacitors

Jinghao Huo,* Yingjie Xiao, Long Fan, Dan Zhao, Yi Liu, Gentian Yue and Shouwu Guo

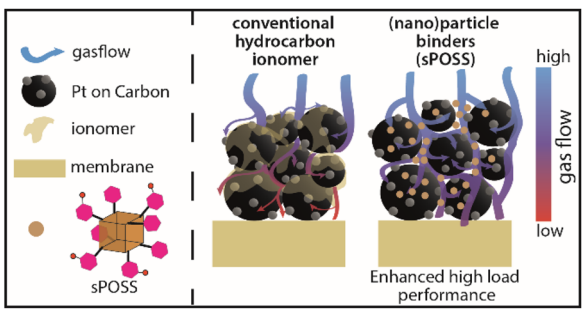
34682



Multifunctional ionogels toughened with spiropyran mechanophores for soft ionotronics

Li Chang, Jianmin Yang, Haitao Deng, Zhi Chen, Yan Yang and Ziquan Cao*

34696



Fluorine-free sulfonated polyhedral oligomeric silsesquioxanes: replacing polymeric binder in fuel cell catalyst layers

Julian Stiegeler, Sophia K. Kilian, Marco Viviani, Hannes Liepold, Carolin Klose, Andreas Münchinger* and Tym de Wild*

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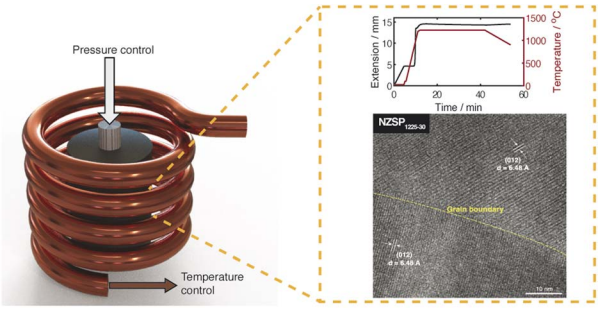
34706

Reactive hot-pressed $Na_{3.4}Zr_2Si_{2.4}P_{0.6}O_{12}$: nanoscale grains, glass-free microstructure, high total conductivity, enhanced chemical stability

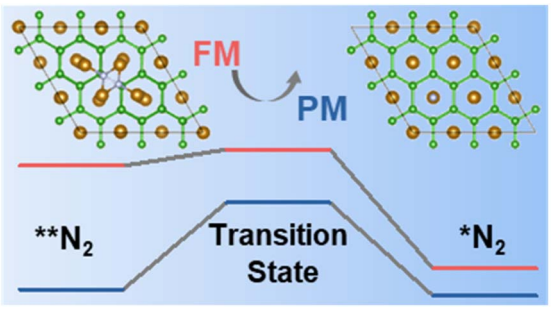
Kang-Ting Tseng, Zhengwu Fang, Bin Wang, Thomas P. Vaid, Amelia Reach, David Kwabi, Miaofang Chi, Jeffrey B. Wolfenstine and Jeff Sakamoto*



34721

Demagnetization-driven enhancement of electrochemical nitrogen reduction on two-dimensional magnetic transition metal borides

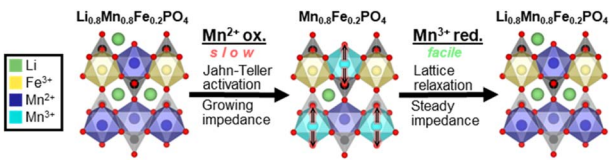
Shiyao Wang, Chunmei Ma, Yurong An and Junjie Wang*



34730

Delineating the kinetic limitations of $Mn^{2+/3+}$ redox in $LiMn_xFe_{1-x}PO_4$ cathodes for lithium-ion batteries

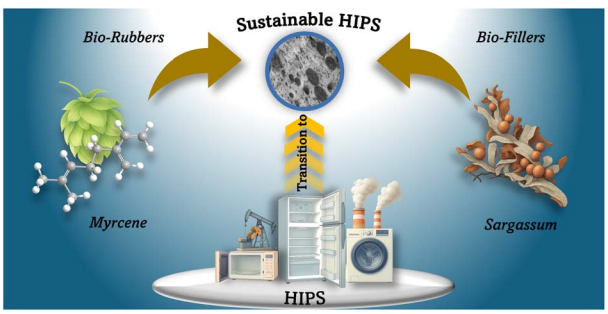
Seth Reed and Arumugam Manthiram*



34741

A dual pathway to make high-impact polystyrene more sustainable: integration of terpene-based rubbers and marine *Sargassum* fillers

Ilse Magaña, Francisco Vilaplana, He Li, Luis Valencia* and Ramón Díaz de León*



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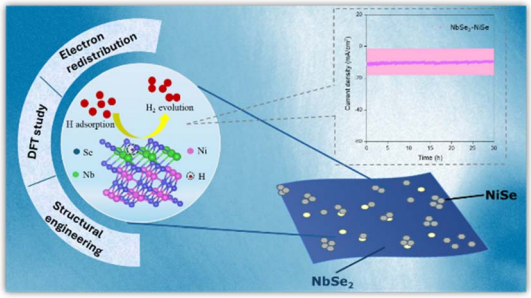
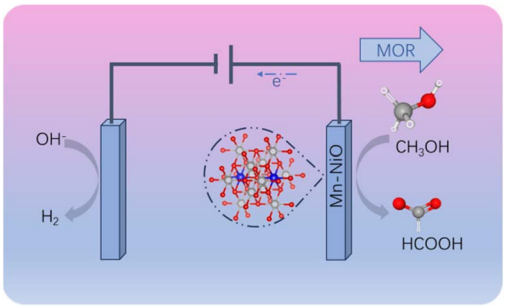
34761



Electron redistribution assisted enhanced hydrogen evolution activity of $NbSe_2$–NiSe nanoheterostructures

Varsha Jha, Ankita Kumari, Md. Samim Hassan, Shubham Kumar, Reetika Tamang, Jyoti Yadav, Dibyajyoti Ghosh and Sameer Sapra*

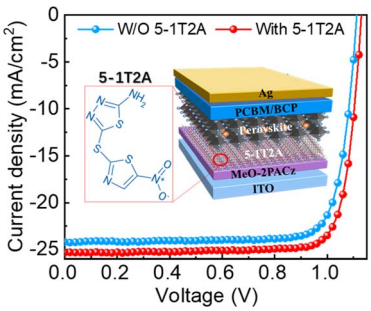
34772



Mn-modified nickel oxide for selective methanol oxidation: a route toward integrated formate electrosynthesis and hydrogen generation

Ning Jian, Yi Ma, Huan Ge, Yong Zhang, Jiwei Hu, Yun Ke, Chaochao Li, Jing Yu, Jordi Arbiol, Junfeng Liu, Andreu Cabot and Junshan Li*

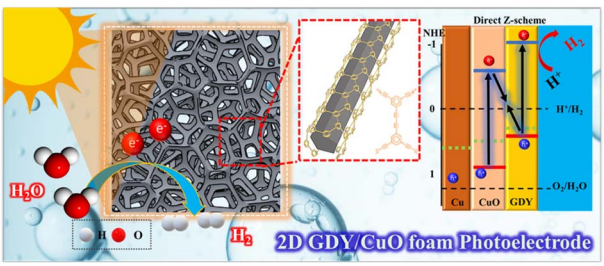
34782



Enhancing inverted perovskite solar cell performance *via* buried modification for improved interface and stability

Xinying Chen, Yingqi Zuo, Henglin Mo, Jiateng Chen, Qiaofei Hu, Zhen He, Xiaoying Huang, Jiang Wang, Jian Xiong* and Jian Zhang*

34793



A direct Z-scheme-based 2D graphdiyne/cupric oxide heterojunction for enhancing solar-to-hydrogen conversion efficiency

Hoki Son, Seongho Kang, Eungbeom Yeon, Seungwan Woo, Hyegyeong Hwang, Eunbee Jung and Jinsung Kwak*

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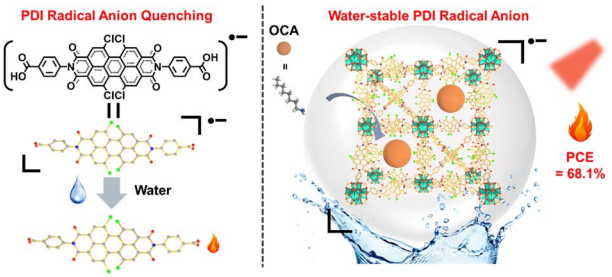
34804

Water-stable perylene diimide radical anions in a metal–organic framework for efficient solar-thermal conversion and steam generation

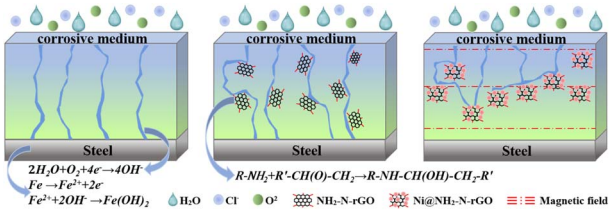
Junxiao Wang, Klaus Müllen, Jun Guan* and Meizhen Yin*



34813

Corrosion resistance of hydrangea-like nano-Ni/amino N-doped rGO epoxy composite coatings constructed *via* magnetic field-oriented alignment

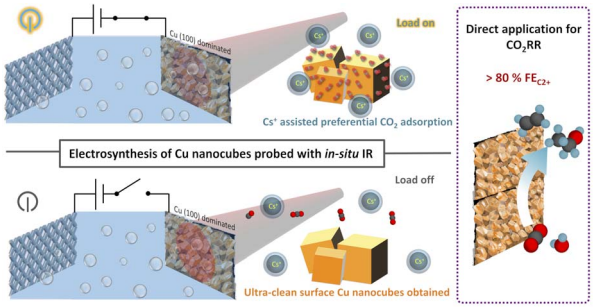
Peng Wang, Jian Wei,* Yanbin Zhang, Enhao Lv, Yi Yao, Jing Liu, Bowen Xin and Xueting Li



34827

Cation- and CO_2-assisted electrochemical synthesis of clean, shape-controlled Cu nanocrystals for selective CO_2 reduction to C_2^+ products

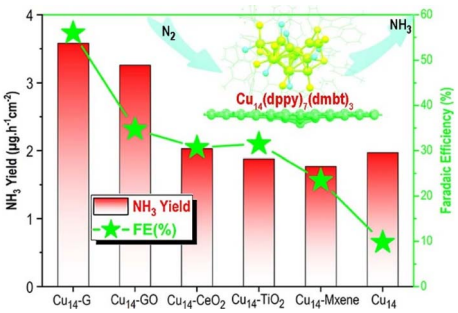
Wei-Ting Tu, Tsung-Han Tsai, Ding-Huei Tsai, Yi-Ting Xie, Hsuan-Yu Liu, Ming-Kang Tsai,* Tsu-Chin Chou* and Yung-Tin (Frank) Pan*



34836

A $Cu_{14}(dppy)_7(dmbt)_3$ cluster of chelating structure for enhanced electrocatalytic nitrogen reduction to ammonia

Aamir Shehzad, Ran Cheng, Fang Zhang and Zhixun Luo*



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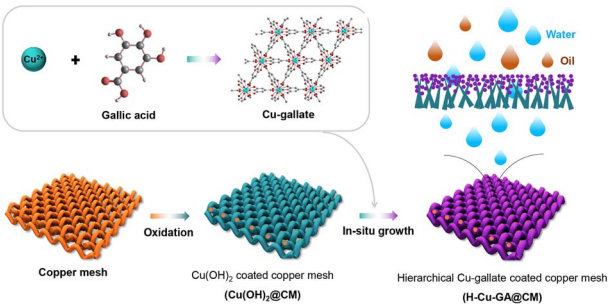
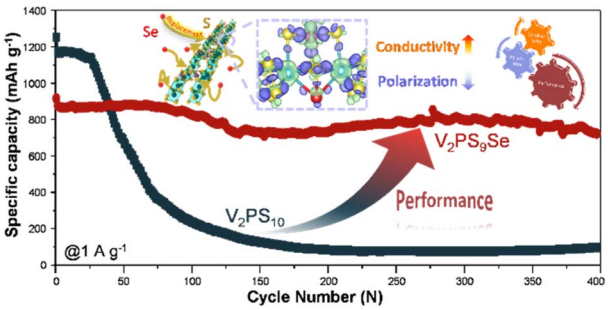


A hierarchical Cu-gallate-based mesh membrane for oil/water separation

Yinlu Fan, Yuxin Li, Jiu Shi and Yanwei Sun*

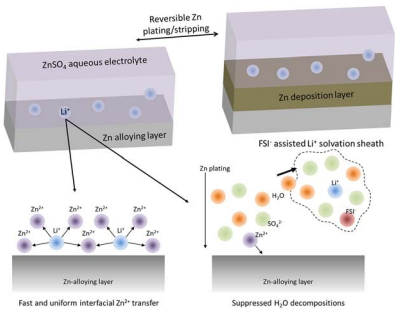
34851



A novel 1D van der Waals $V_2PS_xSe_{10-x}$ ($x = 7$–10) anode for enhanced electrochemical kinetics and high-rate performance *via* Se alloying in lithium-ion batteries

Xiaojie Zhang, Xue Dong, Chaeheon Woo, Yeongjin Kim, Jinsu Kang, Kyung In Kim, Yeong Hyeop Kim, Donghyeon Lee, Minjae Kim, Junyoung Mun,* Hak Ki Yu* and Jae-Young Choi*

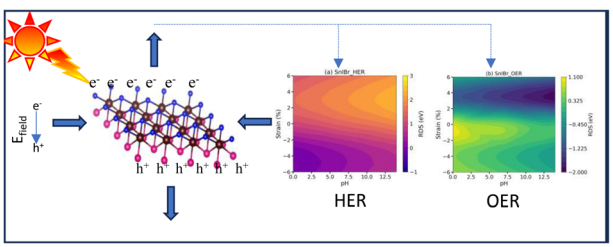
34861



Lithium ion mediated interfacial transfer and solvation structure enable stable zinc-alloying interface for aqueous zinc battery

Xin Zhou, Zheng Qian, Zhendong Li, Deyu Wang, Zhenlian Chen,* Xiayin Yao* and Zhe Peng*

34873



Design of novel SnIX (X = Br/Cl) Janus layers: electronic, optical, and photocatalytic properties, as well as defect and strain engineering

Anjana E. Sudheer, Golla Tejaswini, Matthias Posselt and D. Murali*

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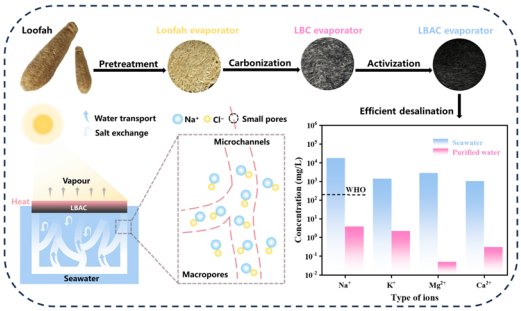
34896

A loofah-derived biological activated carbon enhanced solar interfacial evaporator for efficient and stable seawater desalination and wastewater purification

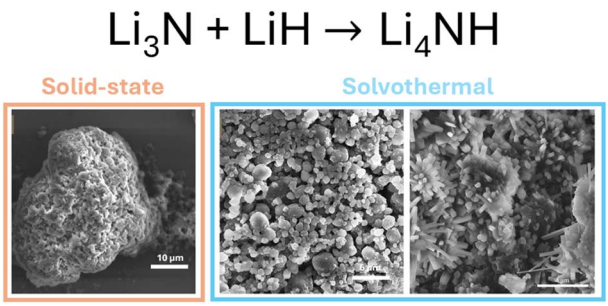
Lianghao Deng, YueJun Liu, Tong Liu,* Xuelei Hu* and Yao Wang*



34907

A solvothermal approach to nano-designing M-N-H systems: unveiling new pathways to dimensional control in the lithium nitride hydride ammonia synthesis catalyst

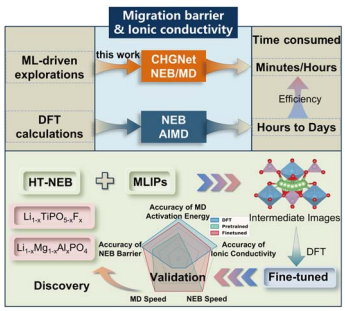
Fatima M. Abi-Ghaida* and Joshua W. Makepeace



34918

High-throughput NEB for Li-ion conductor discovery *via* fine-tuned CHGNet potential

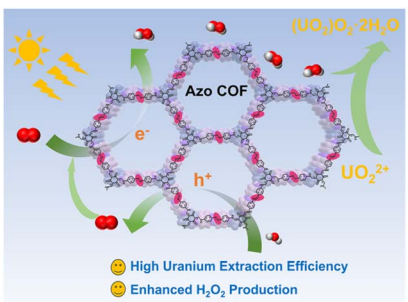
Jingchen Lian, Xiao Fu, Xuhe Gong, Ruijuan Xiao* and Hong Li



34927

An unsaturated bond strategy in covalent organic frameworks for enhanced simultaneous photocatalytic uranium recovery and hydrogen peroxide production

Bing Han,* Zhuo Wang, Yue Wen, Yijia Xu, Qi Wang and Zhuoyu Ji*



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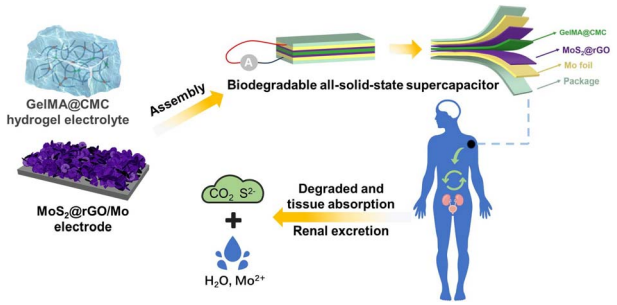

A biodegradable and flexible solid-state supercapacitor based on a natural polymer dual network hydrogel electrolyte

Xu Zeng, Yankun Guo, Xin Wei, Peiyu Cui, Junlong Yao, Yani Guo* and Yimin Sun*

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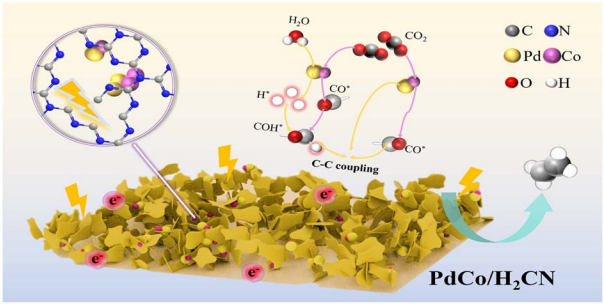
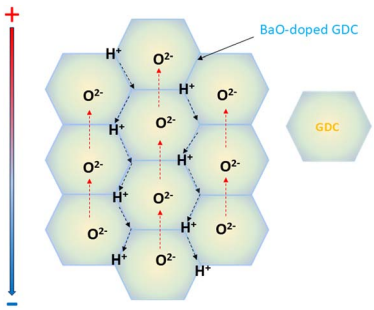


Nitrogen vacancies rich C_3N_4 supported PdCo catalyst for selective photocatalytic CO_2 reduction to C_2H_4

Chao Huang, Xuelian Yu,* Guocheng Lv, Yingmo Hu and Libing Liao

34955



Super-high dual-ion conductivity of BaO-doped GDC electrolytes for solid oxide fuel cells

Xiangcheng Liu, Qiuning Li, Lingping Zeng, Tengpeng Wang, Dehua Dong* and Huanting Wang*

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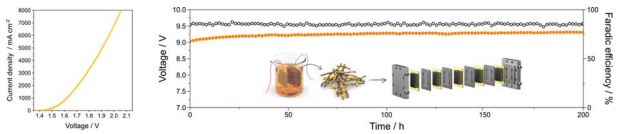

Unified anodes with different nickel–iron-based phases for durable AEM electrolyzers achieving high performance of 8000 mA cm^{-2} at 2.05 V

SungBin Park, Hosung Choi, Geumbi Na, Hee Ji Choi, Dae Hyun Lee, Min Seok Gi, Ji Eun Park,* Yong-Hun Cho* and Yung-Eun Sung*

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