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纳米研究 (英文)

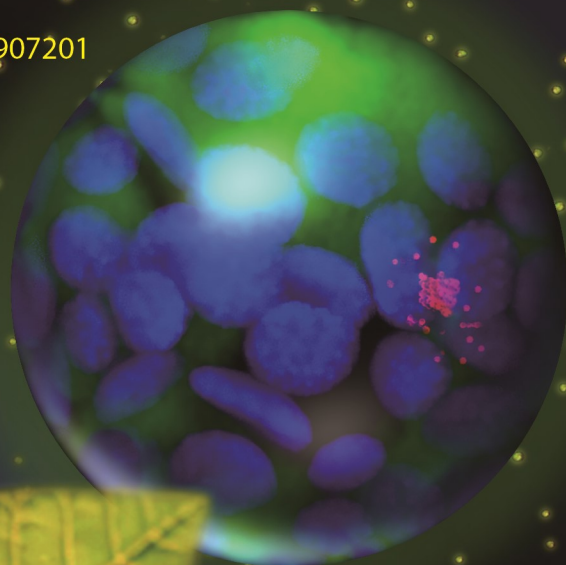
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Volume 18 · Number 3

Optical ratiometric silica pH sensors unveil active transport
and subcellular particle localization in protoplasts

94907201



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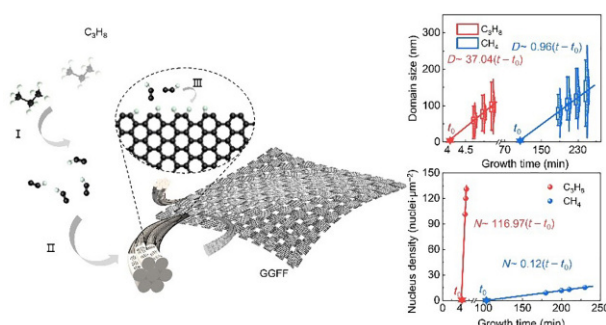
Carbon

Research Articles

Rapid preparation of graphene-skinned glass fiber fabric based on propane as carbon source

Longfei Liu, Jianjian Shi, Wenjuan Li, Kangyi Zheng, Hao Yuan, Fushun Liang, Ruojuan Liu, Yuyao Yang, Fan Yang, Shuting Cheng, Wenjing Jiang, Qingxu Su, Jingnan Wang, Yuejie Zhao, Mengxiong Liu, Ce Tu, Mengwei Li, Xiaobai Wang*, Xiaoli Sun*, Yue Qi*, and Zhongfan Liu*

In this paper, we have innovatively used a propane carbon source to rapidly grow graphene on glass fiber fabric (GFF). The high growth rate of domain area size and nucleation rate of propane carbon source result in accelerated growth rates (~ 50 times faster) compared to the conventional carbon source methane.



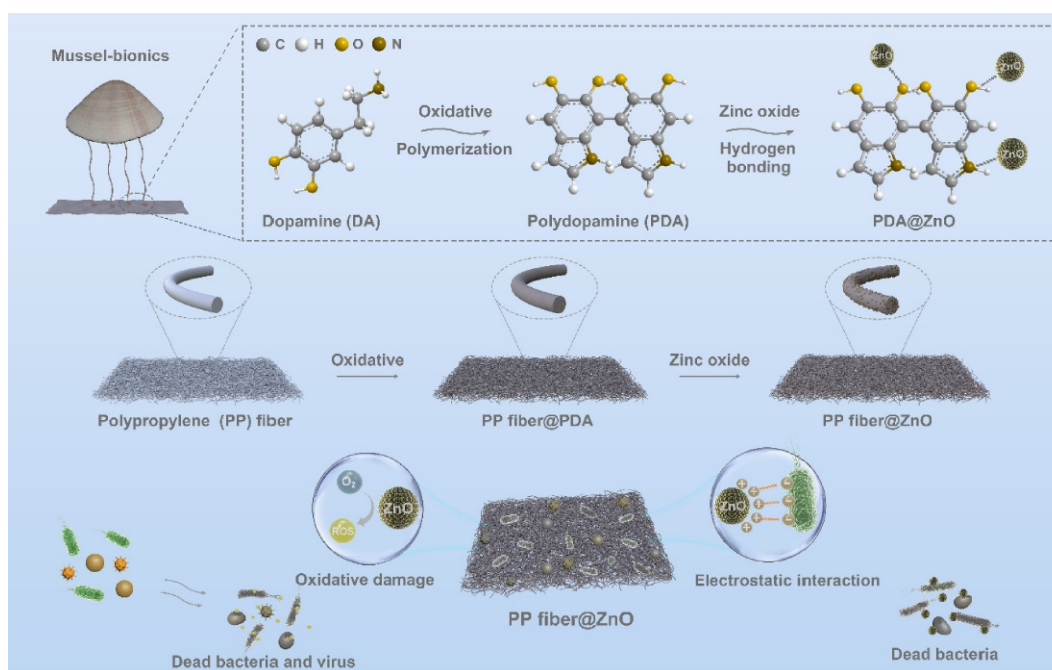
Nano Research, 2025, 18, 94907217

<https://doi.org/10.26599/NR.2025.94907217>

Mussel-bionic fiber@ZnO composite membrane for self-cleaning antibacterial mask

Yong Wang, Wen-Bo Zhao, Fu-Kui Li, Shulong Chang, Bao-Shuai Shi, Lin Jia, Kai-Kai Liu*, and Chong-Xin Shan*

The self-cleaning antibacterial mask constructed from the fiber@ZnO composite membrane and inspired by mussel adhesion, demonstrates excellent antibacterial and antiviral performance.



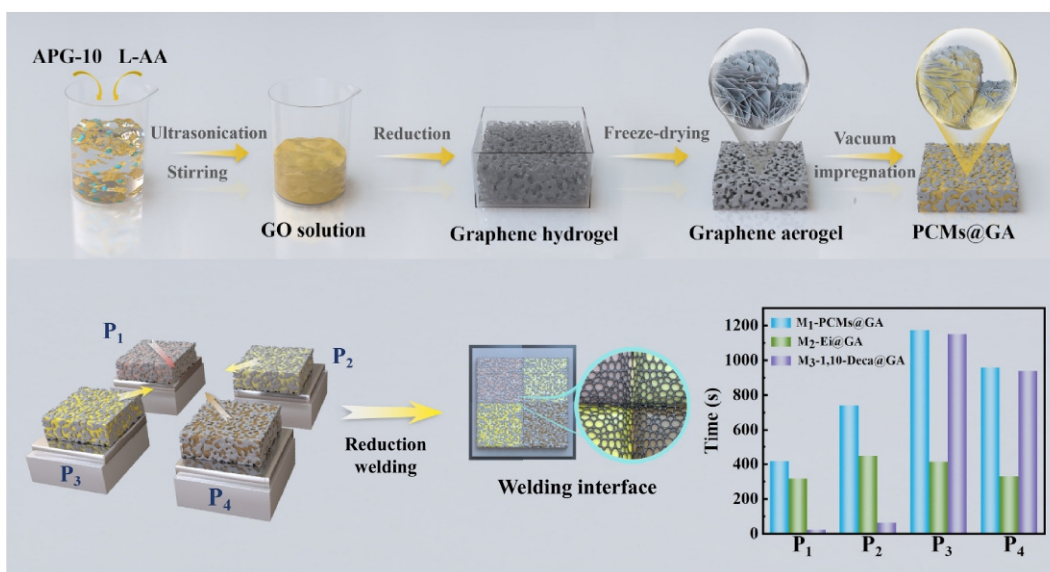
Nano Research, 2025, 18, 94907205

<https://doi.org/10.26599/NR.2025.94907205>

Custom-assembled phase change modular devices for personalize speciality: Carbon energy thermal management application

Yilin Chen, Huitao Yu, Yiyu Feng*, and Wei Feng*

In this paper, we customized the assembly of four graphene aerogel-based phase change composites with significant differences in phase change temperatures to obtain an integrated modular thermal management device. Compared with a homogeneous module, it can keep the temperature stable for a longer period of time under multiple and complex heat generation scenarios, which improves the thermal management efficiency.



Nano Research, 2025, 18, 94907202

<https://doi.org/10.26599/NR.2025.94907202>

Catalytic

Review Articles

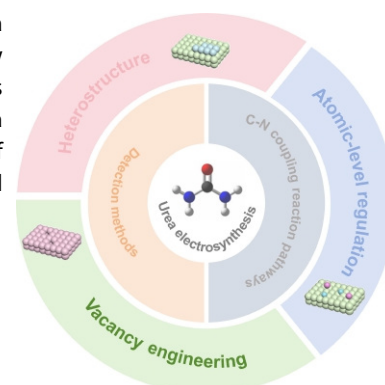
Advances in electrocatalytic urea synthesis: Detection methods, C-N coupling mechanisms, and catalyst design

Jian Cai, Zixuan Wang, Xuan Zheng, Jiace Hao, Kanglin Bao, Ying Zhou, Xiaodan Pan, and Han Zhu*

Nano Research, 2025, 18, 94907232

<https://doi.org/10.26599/NR.2025.94907232>

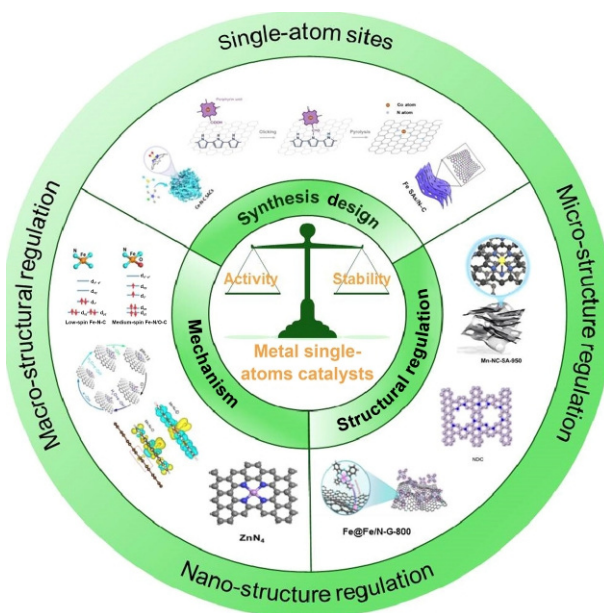
This review explores reliable urea detection methods, essential raw materials, and reaction pathways pertinent to urea synthesis, with a focus on the critical role of electrocatalysts in electrochemical urea production.



Recent progress on understanding of micro- and electronic-structures to synergistically enable the activity and stability for oxygen reduction

Yao Liu, Ruisi Li, Junjun Xia, Chenyang Shu, Jianhong Liu, Shaoxin Yan, Rong Jin, Haifeng Chen, Liumei Teng, Yujun Si, Chaozhong Guo*, Yuxin Zhang*, and Quan Xu*

This paper focuses on understanding the micro- and electronic structures that synergistically enable the activity and stability of oxygen reduction. It aims to establish a balance between the catalytic activity and stability of metal single atoms, thereby providing a theoretical foundation for understanding the synergistic catalytic mechanisms and long-term stability of catalytic sites in complex heterogeneous environments, ultimately advancing the development of low-cost, high-efficiency, and high-stability single-atom catalysts.



Nano Research, 2025, 18, 94907244

<https://doi.org/10.26599/NR.2025.94907244>

Research Articles

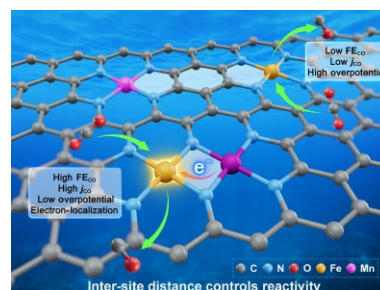
Tailoring the proximity of iron and manganese atomic sites for efficient CO₂ electroreduction reaction

Xiaohui Sun*, Bangyan Zhang, Qing Lu, Jingjing Jiang, Chenliang Ye*, Guoqing Cui, Zechao Zhuang, Jun Zhang, Johannes H. Bitter, Guanna Li*, and Chunming Xu

Nano Research, 2025, 18, 94907249

<https://doi.org/10.26599/NR.2025.94907249>

Nitrogen-doped carbon supported Fe and Mn heteronuclear single atom catalysts with different Fe and Mn inter-site distance were fabricated for CO₂ electroreduction reaction. The catalyst with neighboring Mn and Fe sites showed a CO Faradaic efficiency of 96% at a low overpotential of 320 mV with a Tafel slope of 62 mV·dec⁻¹. The adjacent Mn enhanced the electronic localization of Fe, on which *COOH formation and CO* desorption were boosted.

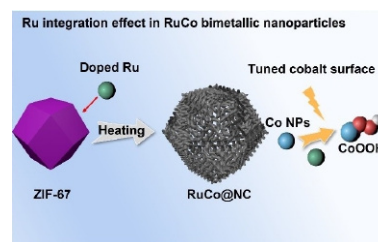


Promoting mechanism of the Ru-integration effect in RuCo bimetallic nanoparticles for enhancing water splitting performance

Mengtian Huo, Yifan Li, Qianyu Li, Xinye Zhang, Xinran Sun, Huiying Wang, Zihao Xing*, and Jinfa Chang*

Nano Research, **2025**, 18, 94907243
<https://doi.org/10.26599/NR.2025.94907243>

RuCo bimetallic nanoparticles with atomically-dispersed Ru supported on nitrogen-doped carbon were synthesized. The atomically-dispersed Ru not only acts as the main active site for the hydrogen evolution reaction but also promotes the Co surface to become more prone to oxidation into CoOOH*, thus acting as a high-activity site for the oxygen evolution reaction.

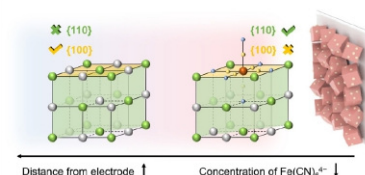


Halophobic Prussian blue analogue electrodes for saturated saline water electrolysis

Wei Liu, Jiage Yu, Boyu Ding, Tianshui Li, Shihang Li, Xinlong Guo, Linlin Zhou, Benqiang Tian, Yixin Zhang, Yizhe Li, Mengze Ma, Kairui Wang, Huijun Xin, Daojin Zhou*, Yun Kuang*, and Xiaoming Sun*

Nano Research, **2025**, 18, 94907246
<https://doi.org/10.26599/NR.2025.94907246>

Most seawater electrolysis cathodes fail to support continuous operation due to NaCl crystallization. Addressing this overlooked issue for the first time, halophobic Pt/NiFe Prussian blue analogue cathodes are constructed, leveraging the self-originated $\text{Fe}(\text{CN})_6^{4-}$ to control the NaCl crystallization site. This innovative prevents the coverage of active sites by NaCl crystals, rendering continuous seawater electrolysis feasible.

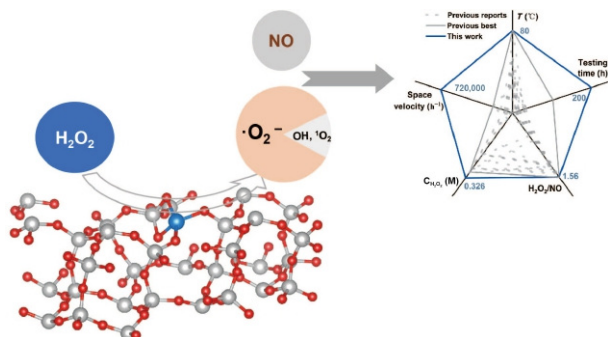


High selectivity of H_2O_2 activation to $\cdot\text{O}_2^-$ for efficient NO oxidation over Co single-atom catalyst

Zhengyang Gao, Zheng Song, Ziwei Miao, Chenliang Ye*, and Weijie Yang*

The Co single-atom catalyst shows high selectivity of H_2O_2 activation to $\cdot\text{O}_2^-$ for efficient NO oxidation.

Nano Research, **2025**, 18, 94907255
<https://doi.org/10.26599/NR.2025.94907255>

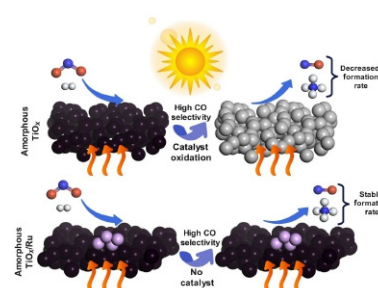


Unveiling the mechanism of selective CO_2 hydrogenation to CO on amorphous black TiO_x in thermal and photo-assisted thermal catalysis: The role of defects in amorphous structure and light irradiation

Mohammad Fereidooni, Mohammad Yazdanpanah, Victor Márquez, C. V. Paz, Martin Salazar Villanueva, Supareak Praserttham, and Piyasan Praserttham*

Nano Research, **2025**, 18, 94907218
<https://doi.org/10.26599/NR.2025.94907218>

The amorphous black TiO_x catalyst exhibited high selectivity towards CO during CO_2 hydrogenation, primarily due to restricted hydrogen mobility on its surface. Additionally, decorating the catalyst with Ru particles significantly enhanced its stability by preventing the loss of oxygen vacancies.

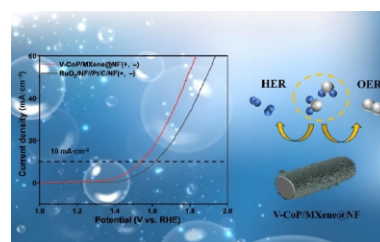


Three-dimensional structured of V-doped CoP *in situ* grown on MXene as highly efficient bifunctional electrocatalyst for water splitting

Hong Wang, Huimin Jiang, Yongqi Niu, Nasir A. Siddiqui, Aslam Khan, Lu Pan*, and Jianjian Lin*

Nano Research, **2025**, 18, 94907238
<https://doi.org/10.26599/NR.2025.94907238>

A novel three-dimensional (3D) structured V-doped CoP grown *in situ* on MXene by one-step hydrothermal and controlled phosphorylation (defined as V-CoP/MXene@NF) bifunctional catalyst was successfully synthesised by one-step hydrothermal and controlled phosphorylation methods. The catalyst exhibits excellent electrolytic water performance, which is attributed to the synergistic effect between metal element doping and MXene.

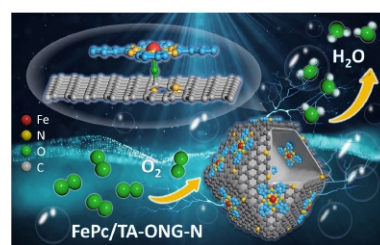


Tailoring the d-band electronic structure of FePc by direct oxygen bridge on ZIF-8 derived ultrathin carbon shell to improve the oxygen reduction performance

Xilin Zhang, Shan Wang, Zhiyi Sun, Zhongjun Ma, Huixuan Wang, Zongxian Yang*, Qingfang Chang*, and Wenxing Chen*

Nano Research, **2025**, 18, 94907235
<https://doi.org/10.26599/NR.2025.94907235>

A novel molecular electrocatalyst featuring with a direct oxygen atom bridging the iron phthalocyanine (FePc) and an ultrathin carbon substrate derived from ZIF-8, namely FePc/TAONG-N, was designed and synthesized. This direct connection with oxygen bridge significantly enhances the interaction between the FePc molecule and the carbon substrate, facilitating electron transfer and leading to an improved durability and activity in oxygen reduction reactions.

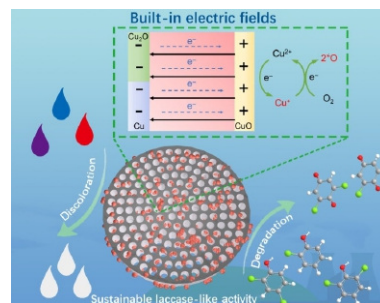


Engineered built-in electric fields in Cu⁰/CuO_x nanozyme-decorated silicon nanodisks for the degradation of phenols and dyes

Sijun Huang, Tianqi Zhang, Shiyin Hong, Dechen Zhang, Yanping Zhao, Miao Li, Ying Wang, Xuewu Liu*, Yi Guo*, and Li Xu*

Nano Research, **2025**, 18, 94907239
<https://doi.org/10.26599/NR.2025.94907239>

Inspired by the oxidation-induced heterogeneous architectures found in nature, a built-in electric field (BIEF) can be harnessed to trigger charge redistribution. This, in turn, leads to a remarkable enhancement in both the catalytic performance and reusability of nanozymes, thereby unlocking their potential for more efficient and sustainable applications.



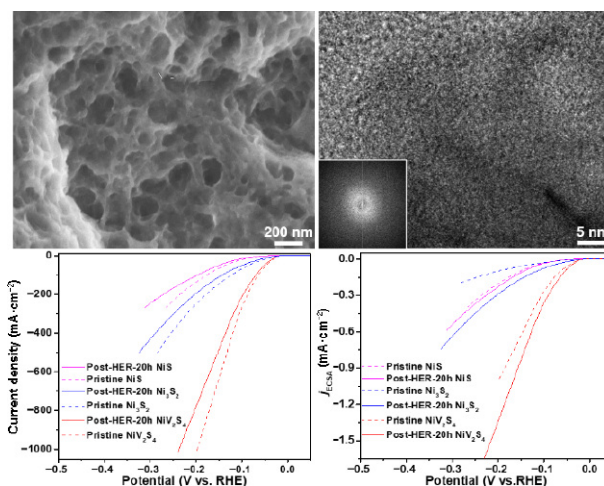
Transition metal sulfides in alkaline hydrogen evolution electrocatalysis: Re-exploring their structure and composition evolution and its correlation with activity

Chengqi Wu, Jiaqi Liu, and Yiwei Tan*

When transition metal sulfides are used as electrocatalysts for alkaline hydrogen evolution reaction (HER), they are gradually degraded to the corresponding amorphous metal hydroxy salts/oxides from surface to bulk with elongating HER time. The apparent HER activities of all the derived metal hydroxy salts/oxides decrease, whereas their specific activities increase.

Nano Research, 2025, 18, 94907240

<https://doi.org/10.26599/NR.2025.94907240>



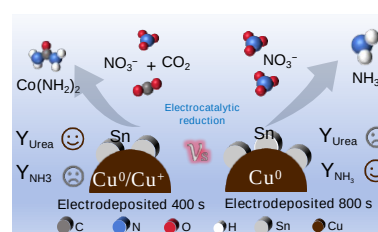
In situ evolution of Sn/Cu₂O heterostructure catalysts for modulating selectivity in electrosynthesis of ammonia and urea

Yinan Zheng, Yuxin Jia, Qiuhan Cao, Lei Li, Xin Yu, Shiqi Zeng, Hu Yao, and Xiaohui Guo*

Nano Research, 2025, 18, 94907248

<https://doi.org/10.26599/NR.2025.94907248>

A kind of advanced bifunctional Sn/Cu₂O electrocatalysts were prepared by *in situ* electro-deposition on copper mesh for the first time. Electrochemical reconstruction of Sn/Cu₂O catalysts exhibits high selectivity for ammonia and urea in NO₃⁻RR and C–N coupling reaction, as well as with robust operation stability. Bi-selectivity to ammonia and urea synthesis achieved by modulating the chemical state of Cu in Sn/Cu₂O catalysts, these results are superior to most reported transition metal-based catalysts in synthesis of urea and/or ammonia.



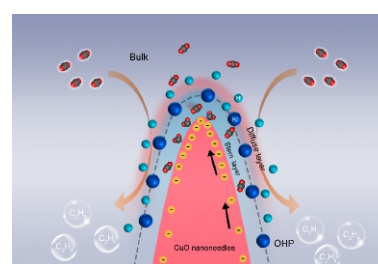
Amplifying cation effects on high-curvature nanostructures via enhancing interfacial electric field for CO₂RR to multicarbon product

Weizheng Tang, Yongjun Shen, Yu Yang, Congcong Li, Yu Li, Shixin Yin, Fengwang Li*, Huihui Li*, and Chunzhong Li*

Nano Research, 2025, 18, 94907200

<https://doi.org/10.26599/NR.2025.94907200>

The high-curvature structure of catalysts facilitates the migration of free electrons, leading to a localized increase in surface charge density at the tip regions and thus an enhanced local electric field. This phenomenon promotes the stabilization of dipolar intermediates and intensifies the cation effect for the highly selective formation of C₂₊ products during CO₂ reduction reaction (CO₂RR).

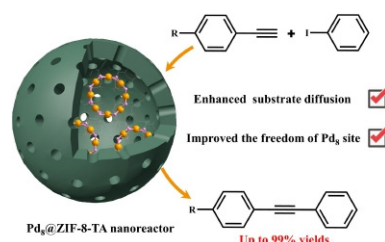


Atomically precise Pd₈ nanocluster encapsulated in a hierarchically engineered nanoreactor towards enhanced catalysis

Hui Yang, Yi-Ming Li*, Jinhui Hu, Dongxia Shi, Yongkang Ge, Jiwei Feng, Hongting Sheng*, and Manzhou Zhu*

Nano Research, 2025, 18, 94907208
<https://doi.org/10.26599/NR.2025.94907208>

Hierarchically engineered metal-organic framework nanoreactor provides atomically precise nanoclusters (NCs) with a capacious microenvironment and enhanced mass transfer, which ultimately boosts the catalytic performance of encapsulated NC, showing much better activity than its confined counterpart and even better than the free NC.

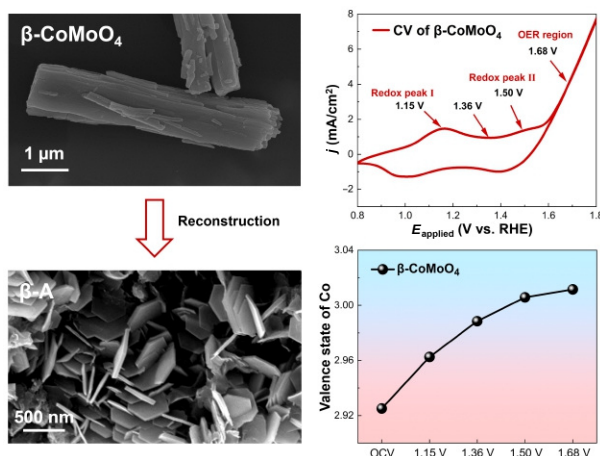


Unveiling the superior oxygen evolution reaction performance of β -CoMoO₄ nanorods: Insights into catalytic mechanisms and active site dynamics

Xinyu Zhong, Yu Chen, Tao Gan, Yuying Huang*, Jiong Li*, and Shuo Zhang*

The β -CoMoO₄ undergoes a complete bulk reconstruction into catalytically active CoOOH, and exhibits strong pre-oxidation capabilities, with a stable low-coordination active structure.

Nano Research, 2025, 18, 94907204
<https://doi.org/10.26599/NR.2025.94907204>

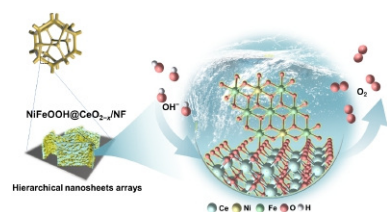


A hierarchical NiFeOOH@CeO_{2-x} nanosheets array boosts electrocatalytic activity and durability at high current densities for water oxidation

Wei Zhang, Liyang Xiao, Xiaorui Huang, Chunyan Han, Ying Liu, Jingtong Zhang, Haiwen Tan, Rui Zhang, Pengfei Yin, Cunku Dong, Hui Liu, Xiwen Du, and Jing Yang*

Nano Research, 2025, 18, 94907213
<https://doi.org/10.26599/NR.2025.94907213>

The hierarchical NiFeOOH@CeO_{2-x} nanosheets array achieves superior alkaline oxygen evolution reaction performance at high current densities, due to abundant activesites, favorable interfacial electron transfer from Ni^{2+/3+} to Ce^{3+/4+}, and improved electrical conductivity owing to oxygen vacancies.

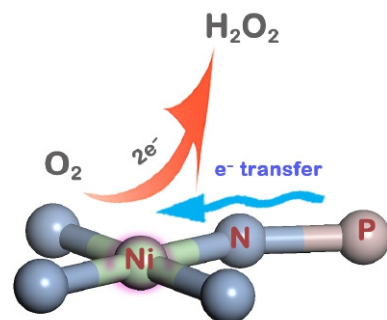


Boosted electrosynthesis of hydrogen peroxide on isolated metal sites through second-shell modulation

Hua Zhang, Nan Zhang, Baojuan Xi, Fei Wan, Kepeng Song, Xuguang An, Shenglin Xiong, and Xiaogang Li*

Nano Research, 2025, 18, 94907211
<https://doi.org/10.26599/NR.2025.94907211>

The electrosynthesis of H₂O₂ is boosted on phosphorus-modulated isolated Ni-N₄ sites. The P atom in the second coordination shell around Ni-N₄ sites triggers the tunable adsorption of OOH* and thus favors the electrocatalytic 2e⁻ oxygen reduction reaction. The constructed NiN₄-P sites on carbon matrix achieve the high selectivity above 90% under the current density of 150 mA·cm⁻² for H₂O₂ generation.



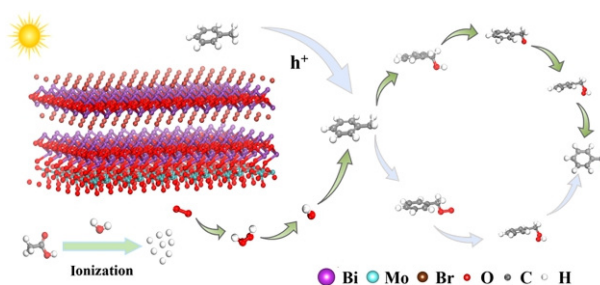
Water enhances photocatalytic activity for toluene selective oxidation in acetic acid solution

Sheng Tian, Jinxin Li, Binghao Wang, Xiong Wang, Xingsheng Hu, Huijuan Wang, Lang Chen*, and Shuang-Feng Yin*

In acetic acid solvent, the introduction of an appropriate amount of water established an acidic environment to facilitate the formation of highly reactive hydroxyl radicals ($\cdot\text{OH}$) through the $\text{O}_2 \rightarrow \cdot\text{O}_2^- \rightarrow \text{H}_2\text{O}_2 \rightarrow \cdot\text{OH}$ process. $\cdot\text{OH}$ and photogenerated holes collaborate to activate $\text{C}(\text{sp}^3)\text{-H}$ bonds, thereby facilitating the conversion of toluene into benzaldehyde.

Nano Research, 2025, 18, 94907206

<https://doi.org/10.26599/NR.2025.94907206>



Energy

Research Articles

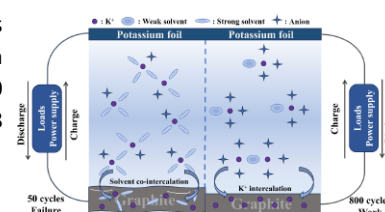
Weakly solvating electrolyte enabling solvent-free co-intercalation for stable potassium-ion storage in graphite

Chaojie Cheng, Wencong Feng, Feiyue Wang, Jingke Ren, Deyang Guan, Wei Chen, Jean-Jacques Gaumet, Kai Fu*, Xiaobin Liao*, and Wen Luo*

Nano Research, 2025, 18, 94907219

<https://doi.org/10.26599/NR.2025.94907219>

Solvent-free co-intercalation enables stable potassium ion storage in graphite anode. A long lifespan of 800 cycles at 0.2 C with a capacity of 171.8 $\text{mAh}\cdot\text{g}^{-1}$ is retained.



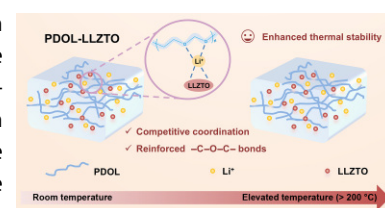
Competitive coordination enhancing the thermal stability of PDOL electrolytes for safe solid-state lithium metal batteries

Ying-Ying Pei, Jiang-Kui Hu, Hong Yuan*, Shi-Jie Yang, Xi-Long Wang, Zheng Liao, Jia Liu, Bo-Quan Li*, and Jia-Qi Huang*

Nano Research, 2025, 18, 94907220

<https://doi.org/10.26599/NR.2025.94907220>

A competitive coordination mechanism is proposed to enhance the thermal stability of poly(1,3-dioxolane) (PDOL) electrolytes, which is based on strong Lewis acid-base interactions between the surface Lewis base sites on $\text{Li}_{6.75}\text{La}_3\text{Zr}_{1.75}\text{Ta}_{0.25}\text{O}_{12}$ (LLZTO) and solvated Li^+ . This interaction strengthens the bond energy of -C-O-C- bonds and weakens the ionic-dipolar interactions between Li^+ and PDOL chains.

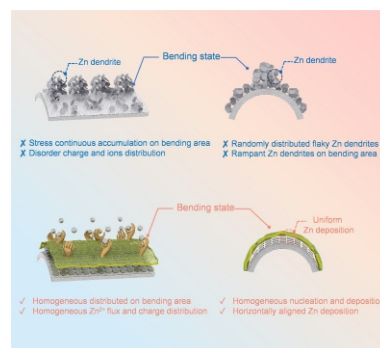


Stabilizing zinc anodes with robust interfacial layer at bending states toward flexible zinc batteries

Jianguo Chen, Yuwei Zhu, Fanlai Zhang, Yizhou Wang*, Wendi Xu, Yu Zhang, Li Shi, Xing Qiang, Yanwen Ma*, and Jin Zhao*

Nano Research, 2025, 18, 94907224
<https://doi.org/10.26599/NR.2025.94907224>

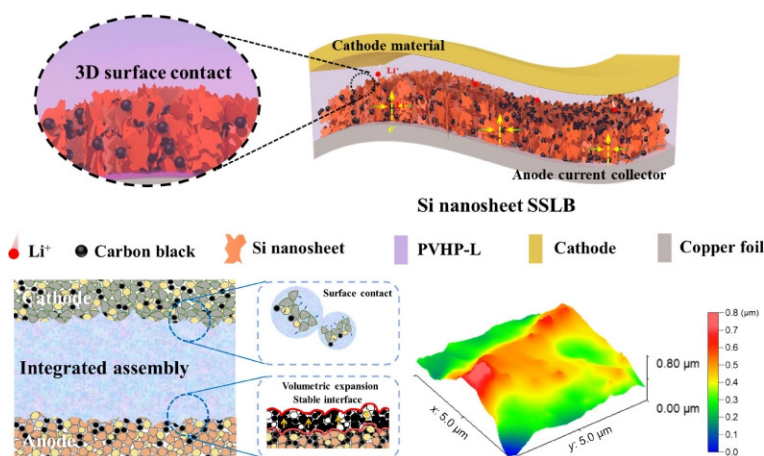
The development of a robust interfacial layer (RIL) for Zn metal anodes in aqueous Zn-ion batteries suppresses dendrite growth and enhances cycling performance. The RIL film regulates Zn deposition, even under extreme bending, significantly improving the stability and flexibility of Zn/MnO₂ batteries, making them suitable for flexible wearable applications.



Designing polymer composite electrolyte and Si nanosheets electrode for integrated silicon-based solid-state battery

Xianzheng Liu*, Xintong Wang, Feng Li, Huaying Qiao, Lihua Jiang, Zhiyuan Wan, Zhigang Wei, and Xiaoming Liu

By designing and fabricating a high-performance composite solid electrolyte and employing a secondary coating process, an integrated silicon-based solid-state lithium battery (Si-SSLB) was constructed. This integrated battery design significantly improves the solid-solid interfacial contact between the electrode and electrolyte, providing more active sites and pathways for ion transfer.



Nano Research, 2025, 18, 94907230
<https://doi.org/10.26599/NR.2025.94907230>

Fabrication

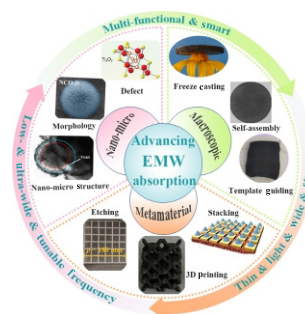
Review Article

Advancing microwave absorption: Innovative strategies spanning nano-micro engineering to metamaterial design

Beibei Zhan, Xiaosi Qi*, Jing-Liang Yang, Xiu Gong, Junfei Ding, Yanli Chen, Fuzhong Wu, and Wei Zhong

Nano Research, 2025, 18, 94907209
<https://doi.org/10.26599/NR.2025.94907209>

Innovative strategies ranging from nano-micro engineering to metamaterial design are explored to advance microwave absorption.



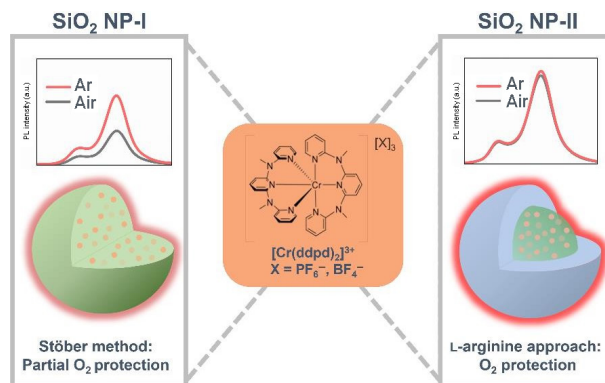
Research Article

Complete protection of NIR-luminescent molecular rubies from oxygen quenching in air by L-arginine-mediated silica nanoparticles

Viktoriia Osipova, Isabella Tavernaro*, Lingcong Ge, Winald R. Kitzmann, Katja Heinze, Michael R. Reithofer, and Ute Resch-Genger*

The application of emerging luminophores like near-infrared emissive chromium(III) complexes and triplet-triplet annihilation upconversion systems requires efficient strategies to protect them from oxygen-induced luminescence quenching. Our study found that silica nanoparticles synthesized using the L-arginine sol-gel method provided complete oxygen protection for these luminophores, offering a promising approach for their use in bioimaging and energy conversion applications.

Nano Research, 2025, 18, 94907241
<https://doi.org/10.26599/NR.2025.94907241>



Front Cover

Material composition

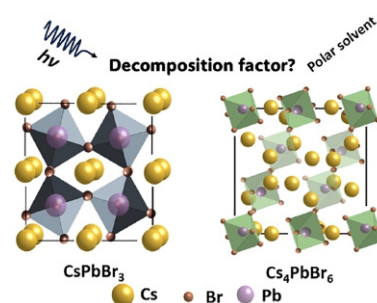
Research Articles

Exploring halide perovskite nanocrystal decomposition: Insight by *in-situ* electron paramagnetic resonance spectroscopy

Anastasiya Sedova, Philip N. Immanuel, Raanan Carmieli, Hila Shalom, Achiad Goldreich, Alen S. Thomas, Jonathan Prilusky, Akshay Puravankara, Ido Bar-On, and Lena Yadgarov*

Nano Research, 2025, 18, 94907210
<https://doi.org/10.26599/NR.2025.94907210>

Electron paramagnetic resonance (EPR) spectroscopy reveals radical-induced decomposition in zero-dimensional (0D) Cs₄PbBr₆ and three-dimensional (3D) CsPbBr₃ nanocrystals, where the polar solvent initiates degradation and light exposure accelerates radical formation. 3D CsPbBr₃ decomposes faster and boosts photocatalytic efficiency, offering insights for enhancing halide perovskite stability.

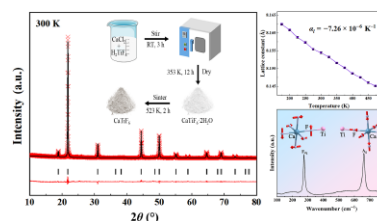


Synthesis, electronic property, and negative thermal expansion in cubic CaTiF₆

Kaiyue Zhao, Peixian Zhang, Yixin Jiao, Fei Wang, Juan Guo, Yongqiang Qiao*, Qiang Sun, and Qilong Gao*

Nano Research, 2025, 18, 94907236
<https://doi.org/10.26599/NR.2025.94907236>

A facile low temperature synthesis strategy was proposed to prepare the cubic phase CaTiF₆ and the negative thermal expansion (NTE) mechanism was investigated based on the entire Brillouin region.



Morphology

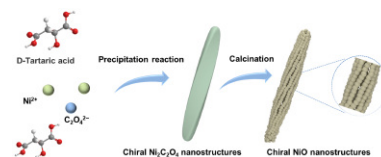
Research Articles

Synthesis of structurally chiral nickel oxide nanostructures for enhanced spin-dependent oxygen electrocatalysis

Yiran Jin, Yang Cheng, Shenghe Dong, Chengyu Xiao, Zhi Chen, and Peng-peng Wang*

Nano Research, **2025**, 18, 94907222
<https://doi.org/10.26599/NR.2025.94907222>

Chiral nickel oxide nanostructures were synthesized using a facile wet chemistry method. These chiral nanostructures enabled the modulation of catalytic reaction kinetics and enhanced the performance for water oxidation through spin control.

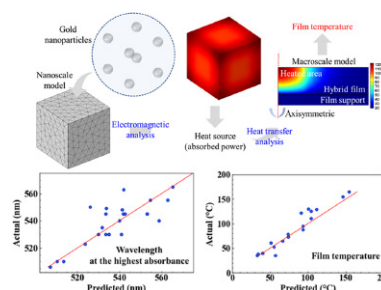


Machine learning approach for predicting optical and photothermal properties of gold nanoparticle/polymer hybrid films: Effect of synthetic data

Yi Je Cho, Harrison Chaney, and Kathy Lu*

Nano Research, **2025**, 18, 94907216
<https://doi.org/10.26599/NR.2025.94907216>

A machine learning (ML) approach coupled with finite element modeling is proposed for predicting the optical and photothermal properties of gold nanoparticle/polymer hybrid films. The addition of synthetic data substantially enhances the accuracy of the ML models, although a threshold for the synthetic data included is present.



Nano biology

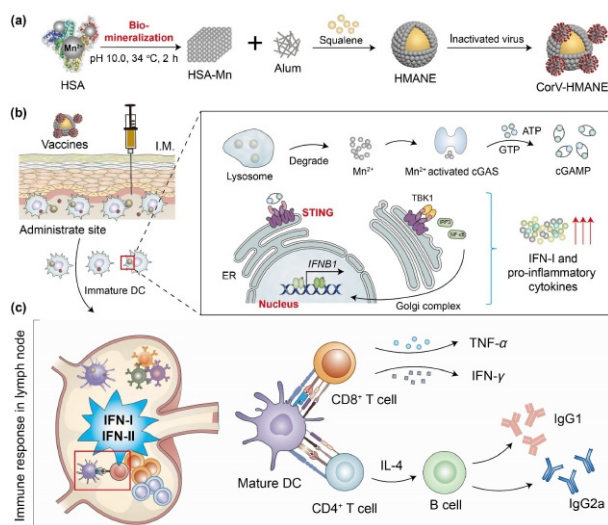
Research Articles

Double-metal ion adjuvant stabilized Pickering emulsion to amplify humoral and cellular immune responses

Zhaofei Guo, Fuhua Wu, Yanhua Xu, Xue Tang, Xiejun Xie, Rui Hu, Yangsen Ou, Hongjiao Wei, Lin Ye, Chunting He, Penghui He, Hairui Wang, Guangsheng Du, and Xun Sun*

The Pickering nanoemulsion HMANE, composed of biomineralized manganese particles (HSA-Mn) and alum adjuvants to emulsify squalene, is mixed with the inactivated virus for vaccination. After inoculation, CorV-HMANE is quickly captured by local antigen-presenting cells (APCs), activating the cGAS-STING pathway and inducing strong adaptive immune responses.

Nano Research, **2025**, 18, 94907237
<https://doi.org/10.26599/NR.2025.94907237>

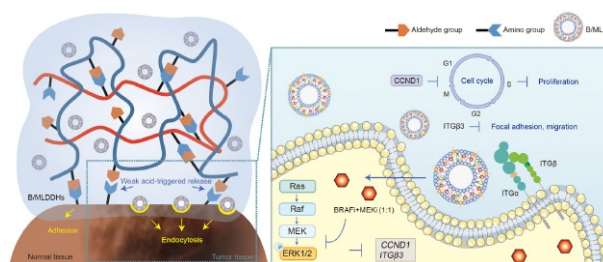


Macro-to-nano dynamic hydrogels in sustained transdermal therapy of diffuse ocular surface malignancies

Jie Chen, Yirong Zeng, Hao Tian, Qixiao Guan, Ziyue Huang, Hongjing Dou*, Shiqiong Xu*, and Renbing Jia*

BRAF/MEKi dual-targeted liposome-doped dynamic hydrogels (B/MLDDHs) serve as a model to treat conjunctival melanoma (CoM). With favorable efficacy and biocompatibility, B/MLDDHs offer a versatile and expandable approach for ocular surface drug delivery applicable to a broader spectrum of ocular surface disorders.

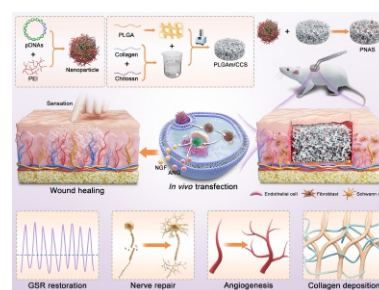
Nano Research, 2025, 18, 94907187
<https://doi.org/10.26599/NR.2025.94907187>



Nerve growth factor/angiogenin gene activated dermal bioscaffold for nerve repair in cutaneous wound healing

Min Yang, Fang He, Chenghao Cai, Yiran Wang, Jiaming Shao, Wei Zhang, Ximing Zhu, Tingting Weng, Ronghua Jin, Tao Shen, Chunmao Han, Pan Wu*, Bin Yao*, Yuqi Zhang*, and Xingang Wang*

This work fabricated a dermal scaffold with dual gene activity, promoting neurological function restoration, nerve repair, angiogenesis, and collagen deposition via over-expression of both nerve growth factor (NGF) and angiogenin (ANG) *in situ*, finally achieved high-quality wound healing.

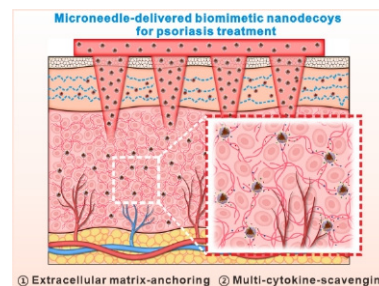


Nano Research, 2025, 18, 94907193
<https://doi.org/10.26599/NR.2025.94907193>

Microneedle-delivered biomimetic nanodecoys target type IV collagen and scavenge multiple cytokines to alleviate psoriatic inflammation

Fei Qu, Jinying Qin, Min Li, Yuting Xia, Yihui Wang, Hongmei Liu, Juan Tao, Yijing Liu*, and Jintao Zhu

This article successfully constructed multi-cytokine-scavenging and extracellular matrix-anchoring nanodecoy integrated microneedle (MN) delivery system to achieve tissue-specific resolution of inflammation. Upon MN delivery, the nanodecoys exhibited significantly enhanced skin retention and multiple cytokines scavenging capability.

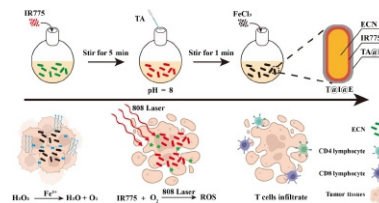


Nano Research, 2025, 18, 94907199
<https://doi.org/10.26599/NR.2025.94907199>

Enhancing the therapeutic efficacy of photodynamic therapy in colon cancer based on an ECN-mediated targeted drug delivery strategy

Kai Wang, Huihui Bian, Tao Ye, Fusheng Shang, Chenxi Zhang, Dagui Chen, Li Su, Heng Yin*, and Liang Zhao*

This study developed a drug delivery system based on *Escherichia coli* Nissle 1917 (ECN), which enhances reactive oxygen species (ROS) generation efficiency at the tumor site through Fe³⁺ catalysis and targeted delivery of the photosensitizer IR775, significantly improving the efficacy of photodynamic therapy for colorectal cancer.



Nano Research, 2025, 18, 94907148
<https://doi.org/10.26599/NR.2025.94907148>

Nano detection

Research Articles

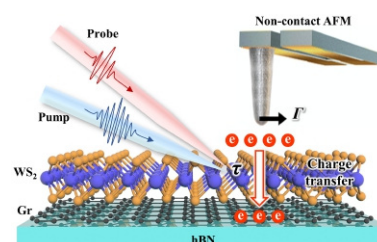
Friction-induced ultrafast charge transfer in van der Waals heterostructures

Chong Wang, Rui Han, Yutang Wang, Shihong Chen, Haowen Xu, Shuchun Huang, Zejun Sun, Huixian Liu, Jianbin Luo*, Dameng Liu*, and Huan Liu*

Nano Research, **2025**, 18, 94907247

<https://doi.org/10.26599/NR.2025.94907247>

The evidence of friction-induced charge transfer in WS₂/graphene heterostructures was demonstrated with ultrafast friction energy dissipation detecting technique.



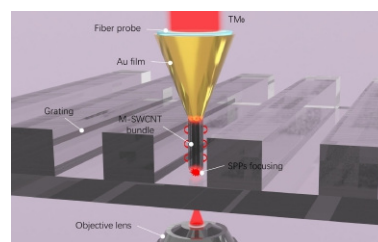
An optical carbon nanotube fibre probe for measurement of nano structures with large aspect ratio

Weihao Tao, Shuhao Zhao, Hanjin Dong, Ze Zhang, Peirui Ji, Shenghan Qin, Wenbo Hu, Jinlong Zhu, Renjie Zhou, and Shuming Yang*

Nano Research, **2025**, 18, 94907254

<https://doi.org/10.26599/NR.2025.94907254>

This carbon nanotube fibre probe has a metallic single-walled carbon nanotubes (SWCNT) bundle at the tip, which can propagate the surface plasmon polaritons (SPPs) to the tip of the metallic SWCNT bundle and form a focusing light field while testing the structure with large aspect ratio. It boasts superior near-field optical imaging capabilities for structures exhibiting a considerable aspect ratio compared with the conventional fibre probe.



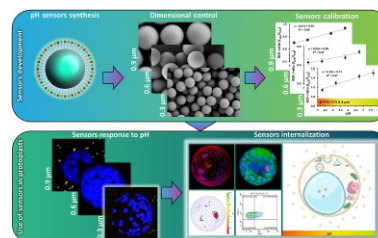
Optical ratiometric silica pH sensors unveil active transport and subcellular particle localization in protoplasts

Helena luele, Lorenzo Maria Curci, Alessio Bucciarelli, Valentina Onesto, Stefania Forciniti, Giuseppe Gigli, Loretta L. del Mercato*, Monica De Caroli*, and Gabriella Piro

Nano Research, **2025**, 18, 94907201

<https://doi.org/10.26599/NR.2025.94907201>

This work reports the synthesis and characterization of dual-function silica-based optical sensors with tunable sizes (100–1000 nm) for imaging particle localization in protoplasts while simultaneously measuring intracellular pH.



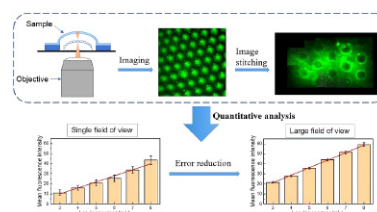
Back Cover

A bionic compound eye for quantitative detection of exosomes

Yuanyuan Liu, Jinxiu Wei, Tingyu Wang, Xuemeng Li, Kuo Yang, Zhuyuan Wang, Lei Wu*, Shenfei Zong*, and Yiping Cui

Nano Research, **2025**, 18, 94907203
<https://doi.org/10.26599/NR.2025.94907203>

This paper presents a bionic compound eye system for quantitative exosome detection, using large-field dual-color fluorescence imaging to improve accuracy in cancer diagnostics.



Nano device

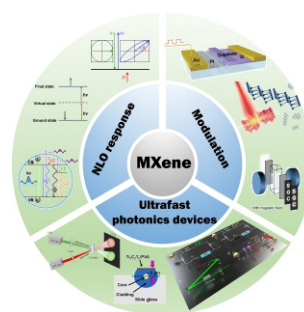
Review Article

MXenes-based nonlinear optical modulator for ultrafast photonics

Shoukai Zhang, Xiaomeng Gao, Yule Zhang, and Yanqi Ge*

Nano Research, **2025**, 18, 94907228
<https://doi.org/10.26599/NR.2025.94907228>

MXenes are promising candidates for nonlinear optical modulators due to their ultrafast carrier dynamics, high optical damage threshold, and tunable properties. This review covers the synthesis methods, integration into optical systems, and the nonlinear optical characteristics of MXenes, while also discusses their applications in ultrafast photonics.



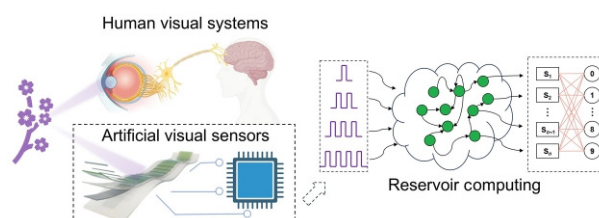
Research Articles

Stretchable artificial vision sensor with retinomorphic transistor-reservoir computing

Tongrui Sun, Xu Liu, Yutong Xu, Xinglei Zhao, Pu Guo, Junyao Zhang, Ziyi Guo, Yue Wu, Shilei Dai*, and Jia Huang*

We present stretchable artificial visual sensors (S-AVS) capable of concurrently sensing and processing optical signals while adapting to shape deformations. The nonlinear response and fading memory effect support in-sensor reservoir computing, achieving image recognition accuracies of 97.46% and 97.1% at 0% and 30% strain, respectively.

Nano Research, **2025**, 18, 94907191
<https://doi.org/10.26599/NR.2025.94907191>

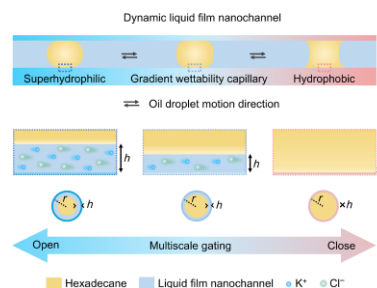


Dynamic liquid film nanochannels for adjustable ion and molecule transport

Chunxiao Liang, Dianyu Wang, Zhe Xu, Haitao Deng, Fan Xia, and Ye Tian*

Nano Research, **2025**, 18, 94907256
<https://doi.org/10.26599/NR.2025.94907256>

Multiscale gating systems have broad applications in drug delivery, microreactors, sieving, biosensing, and other related fields. We construct dynamic liquid film nanochannels within an oil–water–solid system, which is reconfigurable, low-cost, and easy to fabricate. Multiscale gating can be achieved by positioning the oil droplet within regions of varying wettability in the capillary.

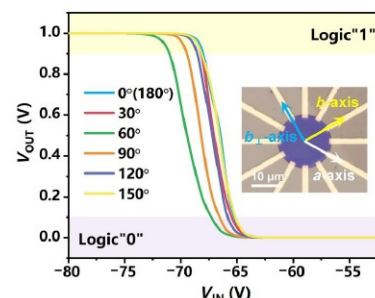


Low-power consumption anisotropic CMOS inverters based on n-ReS₂ and p-WSe₂

Ting Fu, Shuai Liu, Baoxin Niu, Wanfu Shen, Chunguang Hu, Ruixuan Peng, Kai Liu, Chengbao Jiang, and Shengxue Yang*

Nano Research, 2025, 18, 94907231
<https://doi.org/10.26599/NR.2025.94907231>

We report anisotropic complementary metal-oxide-semiconductor (CMOS) inverters based on anisotropic n-ReS₂ and isotropic p-WSe₂. The inverters realize the integration of different voltage transfer characteristics within a single device, combining the benefits of low-power consumption with the potential for high-density integration.

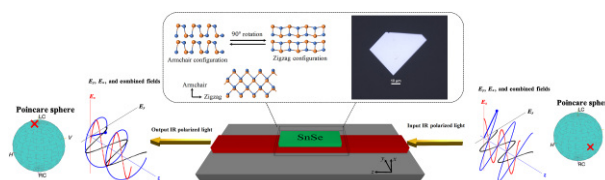


Polarization-encodable photonic memory cells using next-generation 2D phase-change materials

Amin Shafiee, Linhong Chen, Mahdi Nikdast*, and Jie Yao*

In this study, we demonstrate the proof of concept of polarization-encodable photonic memory cells using tin selenide (SnSe) to implement next-generation photonic memory cells for high-performance computing systems.

Nano Research, 2025, 18, 94907198
<https://doi.org/10.26599/NR.2025.94907198>

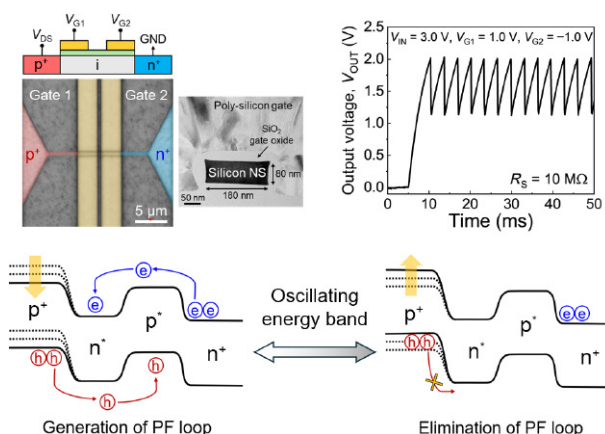


Edge detection and graph coloring by network of oscillatory neuromorphic devices comprising silicon nanosheet-gated diodes

Yunwoo Shin, Hyojoo Heo, Kyoungah Cho*, and Sangsig Kim*

In this research, we demonstrated a network of oscillatory neuromorphic devices to perform edge detection and solve the graph coloring problem. An oscillatory neuromorphic device comprised a silicon nanosheet-gated diode and a resistor. Edge detection was enabled by capacitively coupled devices, and the graph coloring problem was solved using resistively and capacitively coupled oscillatory neuromorphic devices.

Nano Research, 2025, 18, 94907214
<https://doi.org/10.26599/NR.2025.94907214>

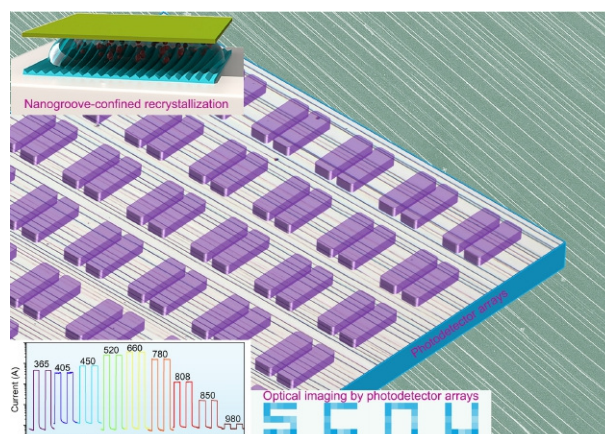


Millimeter-long perovskite nanowire arrays by nanogroove-confined recrystallization seamlessly integrated into high-performance photodetectors for optical imaging

Pingyang Huang, Wei Zhou, Rui Rong, Tiefeng Yang, Xiangtao Chen, Hanyu Liu, Wanglong Mao, Qiming Yang, Zhanhao Liang, Yanbin Chen, Xingyu Wang, Guofu Zhou, and Jinyou Xu*

A facile nanogroove-confined recrystallization method is designed to facilitate the aligned growth of millimeter-long planar perovskite nanowires. These nanowire arrays are then seamlessly integrated into high-performance photodetectors for optoelectronic applications, including optical imaging and Morse code communications.

Nano Research, **2025**, 18, 94907215
<https://doi.org/10.26599/NR.2025.94907215>



Nano unit

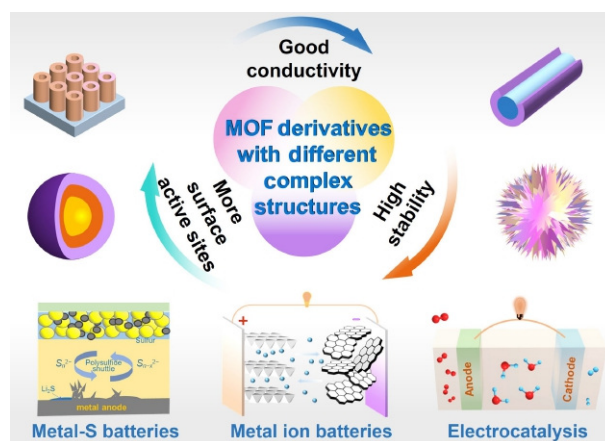
Review Article

Metal-organic framework derivatives with complex architectures: Controllable synthesis and applications

Guangxun Zhang, Hao Li, Qiuqing Wang, Yichun Su, Yangyang Sun, and Huan Pang*

This review introduces the various synthesis methods of metal-organic framework (MOF) derivatives with different complex architectures. Applications of MOFs derived nanomaterials in electrocatalysis, energy storage, photocatalysis, and sensor are also discussed in detail.

Nano Research, **2025**, 18, 94907229
<https://doi.org/10.26599/NR.2025.94907229>



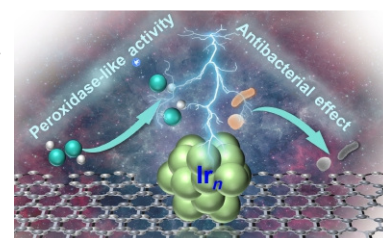
Research Article

Highly efficient layered Ir sub-nanoclusters for antibacterial application

Lini Yang*, Pengbo Zhu, Tao Li, Yueyue Jiao, Xiangbin Cai, Jialan Liang, Hexin Zhang, Ning Wang, Xiaowen Chen*, and Hongyang Liu*

Nano Research, **2025**, 18, 94907234
<https://doi.org/10.26599/NR.2025.94907234>

We fabricated layered Ir-centered nanozymes with desired peroxidase-like activity and antibacterial performance. Compared with atomically dispersed Ir on nanodiamond@graphene (Ir₁/ND@G) single-atom nanozyme (SAzyme) and Ir-NPs/ND@G nanozyme, the Ir_n/ND@G nanozyme can effectively catalyze the conversion of H₂O₂ to hydroxyl radicals, resulting in robust antibacterial abilities.



Semiconductor

Review Article

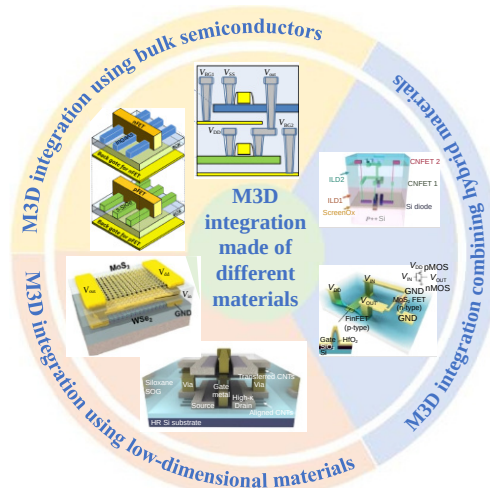
A review on monolithic 3D integration: From bulk semiconductors to low-dimensional materials

Ziying Hu, Hongtao Li, Mingdi Zhang, Zeming Jin, Jixiang Li, Wenku Fu, Yunyun Dai, Yuan Huang*, Xia Liu*, and Yeliang Wang*

This review offers a comprehensive overview of recent advancements in the monolithic three-dimensional (M3D) integration, tracing its evolution from traditional bulk semiconductors to low-dimensional materials. We also summarize the key applications of M3D integrated circuits, including logic circuits, static random access memory, various types of sensors, and artificial intelligence (AI) computing.

Nano Research, 2025, 18, 94907225

<https://doi.org/10.26599/NR.2025.94907225>



Research Articles

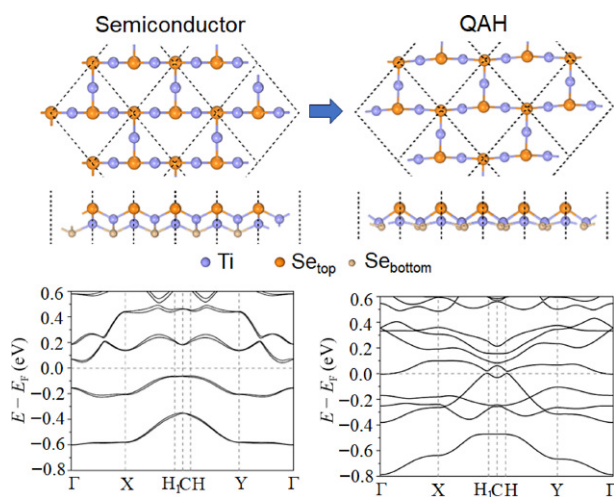
Exploring potential for semiconductor to quantum anomalous Hall insulator transitions via substrate-induced structural modifications in Ti_3Se_4 monolayers

Zhipeng Song, Haixia Cheng, Yun Cao, Qi Zheng, Yurou Guan, Chen Liu, Jierui Huang, Li Huang, Jiaou Wang, Hui Guo, Guangchao Chen, Chengmin Shen, Shixuan Du, Hongliang Lu*, Wei Ji*, Xiao Lin*, and Hong-Jun Gao

Semiconductor materials hold the potential to transform into the quantum anomalous Hall (QAH) materials by adjusting their lattice structure.

Nano Research, 2025, 18, 94907123

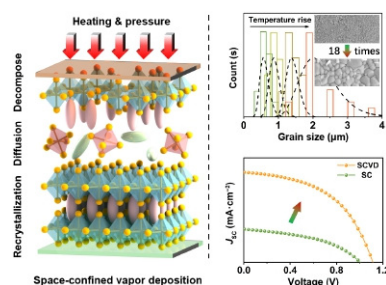
<https://doi.org/10.26599/NR.2025.94907123>



Space-confined vapor deposited molecular ferroelectric film for photovoltaic devices

Chen Wang, Shan Cong*, Lingbo Xiao, Chao-ran Huang, Ruonan Wang, Ruijie Li, Lutao Li, Guifu Zou*, and Qiang Zhang*

Space-confined vapor deposition enables annealing above decomposition temperature to optimize molecular ferroelectric films and enhance photovoltaic performance.



Nano Research, 2025, 18, 94907221

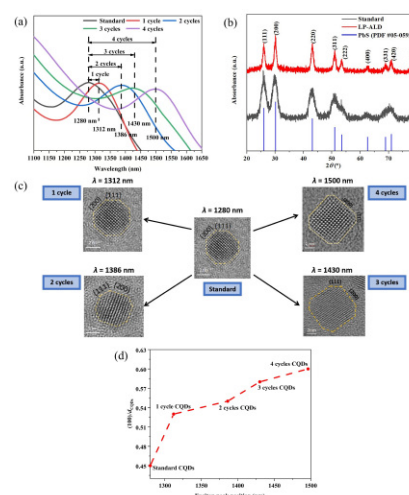
<https://doi.org/10.26599/NR.2025.94907221>

Interfacial coupling enables high carrier mobility in PbS colloidal quantum dot photodetectors

Qing Li, Lier Deng*, Yuxuan Du, Shasha Chang, Shuai Wen, Rui Qin, Jiahong Wang, Wenzhi Feng, Boao Gu, and Huan Liu*

By using the liquid-phase atomic layer deposition method, PbS colloidal quantum dots (CQDs) are induced to grow in a direction that favors coupling. The coupling between specific crystal planes of the quantum dots enables the realization of PbS quantum dot photodetectors with high carrier mobility.

Nano Research, 2025, 18, 94907223
<https://doi.org/10.26599/NR.2025.94907223>



Synthesis

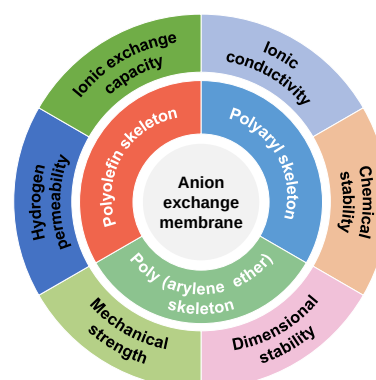
Review Article

Research progress on alkaline anion exchange membranes (AEMs) for the application of hydrogen production by water electrolysis

Qichen Lu*, Xupeng Yan, Weiqi Guo, Guangshan Li, Jinyi Wang, Nan Jiang, Xiaolong Wang, Teer Ba, Peng Liu, Jianing Zhou, Ju Wang, Lin Hu, Tianyi Zhou, Ruling Huang, Bo Hu, Kexin Zhang, and Zhibo Ren*

Nano Research, 2025, 18, 94907252
<https://doi.org/10.26599/NR.2025.94907252>

The review summarized the progress of alkaline anion exchange membranes for water electrolysis and proposed the current challenges and outlooks in this field.



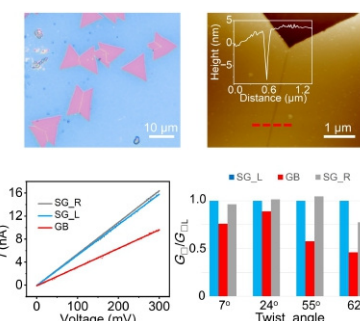
Research Articles

Synthesis of monolayer tungsten nitride: Rapid optical visualization and electrical impact of grain boundaries

Qiuyun Yang, Dehu Li, Fanfan Shi, Zhibin Shao, Na Wang, Yao Peng, Edwin Hang Tong Teo, Zheng Liu*, and Hong Wang*

Nano Research, 2025, 18, 94907242
<https://doi.org/10.26599/NR.2025.94907242>

A chemical vapor deposition method was developed for synthesizing uniform monolayer tungsten nitride (W_2N_3) crystals on SiO_2/Si substrates, and an effective wet-etch approach was introduced for the visualization of grain boundaries (GBs) using optical microscopy. Electrical measurements demonstrated that GBs of monolayer W_2N_3 hinder electrical conduction, serving as barriers to transport.



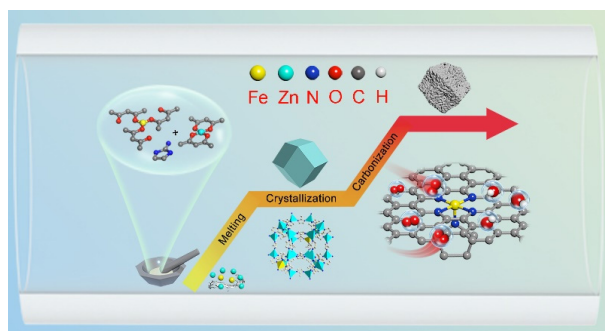
Solid-state stepwise temperature-programmable synthesis of bioinspired Fe-N-C oxygen reduction electrocatalyst featuring Fe-N₅ configuration

Wei Sang, Somboon Chaemchuen, Longyang Zhang, Zechen Wang, Xingchuan Li, Cocoro Andrew Nagasaka, Mo Xiong, Naoki Ogiwara, Cheng Chen, Zhao Wang, Jian Zhang, Francis Verpoort, Shichun Mu, Zongkui Kou*, and Tingting Wang*

A novel solid-state stepwise temperature-programmable (SST) route was developed to achieve direct, facile and green synthesis of bioinspired Fe-N₅-C catalyst. Fe-N₅-C shows excellent electrocatalytic performance (half-wave potential: 0.92 V, current density: 15.6 mA·cm⁻² at 0.85 V), with Fe sites donating 0.1 e⁻ to the axial N ligand, enhancing O₂ activation and *OH desorption.

Nano Research, **2025**, 18, 94907245

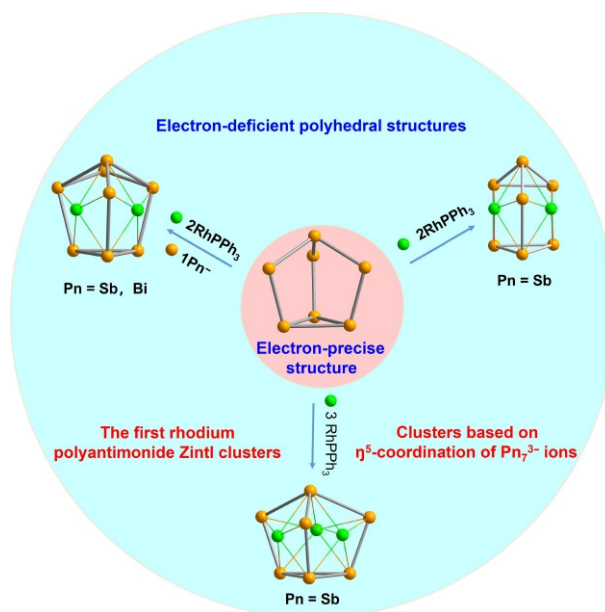
<https://doi.org/10.26599/NR.2025.94907245>



New deltahedral architectures of rhodium-mediated Pn₇³⁻ (Pn = Sb and Bi) cages

Lei Qiao, Chuan-Ling Chen, and Zhong-Ming Sun*

We synthesized a series of heterometallic clusters on the basis of classical Pn₇³⁻ cages via the reaction of K₅Pn₄ (Pn = Sb and Bi) with CpRh(PPh₃)₂ (Cp = C₅H₅, cyclopentadiene). Density functional theory (DFT) calculations revealed three-center-two-electron (3c-2e) RhPn₂ delocalized bonds and weak Rh-Rh interactions for the stabilization of the title clusters. Importantly, this work provides a route to prepare polyhedral hybrid clusters on the basis of Pn₇³⁻ cages.



Nano Research, **2025**, 18, 94907253

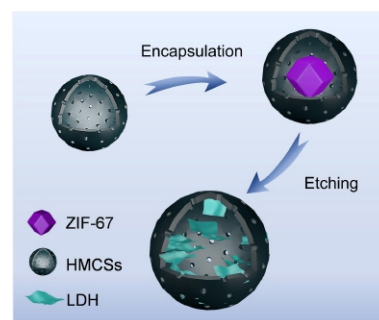
<https://doi.org/10.26599/NR.2025.94907253>

Spatial confinement effect on hollow mesoporous carbon spheres/MOF-derived nanosheets superstructures for improved capacitive deionization performance

Yijian Tang, Shuai Cao, Wanchang Feng, Xiaotian Guo, Yangyang Sun, Songtao Zhang, Huaiguo Xue*, and Huan Pang*

Nano Research, 2025, 18, 94907194
<https://doi.org/10.26599/NR.2025.94907194>

Yolk-shell-structured layered double hydroxide (LDH)@hollow mesoporous carbon spheres (HMCSSs) were synthesized through simple ion etching of ZIF-67@HMCSSs template. The CoNi-LDH@HMCSSs electrode showed higher capacitive deionization (CDI) performance than Co-LDH@HMCSSs and CoFe-LDH@HMCSSs, which attributed to the remarkable synergistic effect between the CoNi-LDH nanosheets and mesoporous N-doped carbon shells.

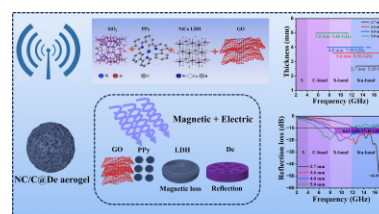


Multistage carbon coupling on three-dimensional multi-space biological templates: A novel strategy for multifunctional microwave absorption aerogel

Dashuang Wang, Tuo Ping, Zhilan Du, Yan Liao, Hong Gao, Xiaobin Gong, Jinsong Rao, Bo Wang, Shicheng Wei, Xiaoying Liu*, and Yuxin Zhang*

Nano Research, 2025, 18, 94907226
<https://doi.org/10.26599/NR.2025.94907226>

Utilizing magnetic-electric synergy and impedance matching effects, a novel NiCo LDH/C@Diatomite (NC/C@De) aerogel has been prepared through the coupling of porous materials and the synergistic action of multilevel carbon materials. This aerogel exhibits broadband electromagnetic wave absorption with an effective absorption bandwidth of 8.56 GHz and a reflection loss minimum of -46.85 dB at a thickness of 2.7 mm.



Theory

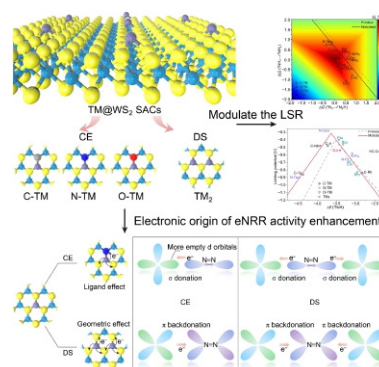
Research Article

Enhanced N₂ electroreduction activity of single-atom catalysts: Modulating the linear scaling relationship by coordination engineering and dual-site strategies

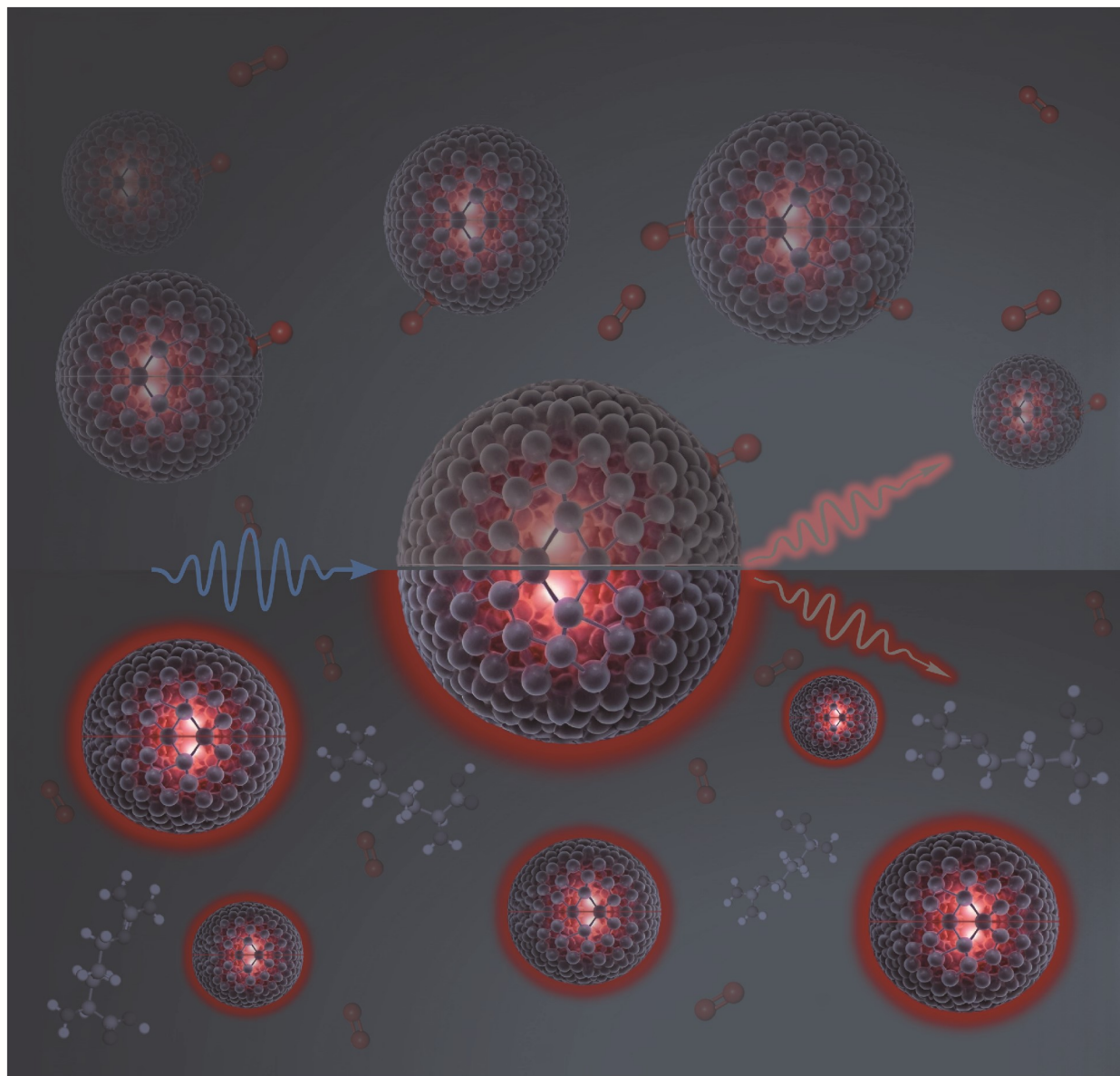
Renyi Li, Caimu Wang, Jiao Zhang, and Wei Guo*

Nano Research, 2025, 18, 94907212
<https://doi.org/10.26599/NR.2025.94907212>

The linear scaling relationship between $\Delta G(*N_2 \rightarrow *N_2H)$ and $\Delta G(*NH_2 \rightarrow *NH_3)$ of TM@WS₂ single-atom catalysts (SACs) can be optimized by coordination engineering and dual-site strategies, bringing the modulated catalyst closer to the ideal active space of electrocatalytic nitrogen reduction reaction (eNRR).



Complete protection of NIR-luminescent molecular rubies from oxygen quenching
in air by L-arginine-mediated silica nanoparticles 94907241



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