



Front Cover

Mechanistic insights into the role of N/O-doped biochar in enhanced phenolics production during biomass pyrolysis

*Zihang Zhang¹, Honghui Li¹, Jinlong Liu, Jusheng Hu, Shurong Wang**

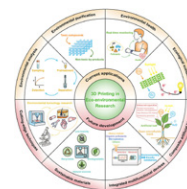
CONTENTS

Viewpoint

Revolutionizing eco-environmental solutions through 3D printing: A strategic vision for future innovations

Xudong Guo, Bin He, Ligang Hu*, Guibin Jiang..... 591

This viewpoint reviews 3D printing's role in eco-environmental research, highlighting progress, challenges, and future strategies like sustainable materials and integrated devices. It introduces a self-sustaining "bionic tree" concept for autonomous environmental remediation and sustainable development.

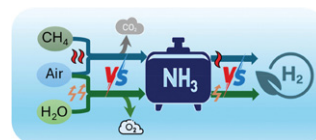


Review articles

Ammonia synthesis and cracking: Thermocatalytic versus electrochemical approaches

Xue Ding, Sze Xing Tan, Lili Zhang, Jiajian Gao*..... 603

This review contrasts thermocatalytic and electrocatalytic pathways for ammonia synthesis and cracking, highlighting their distinct mechanisms, advantages, and limitations. By examining thermodynamics, catalysts, and system integration, we emphasize how emerging electrochemical strategies can complement the industrial maturity of thermocatalysis. The integration of both approaches offers promising routes toward sustainable hydrogen production and a low-carbon ammonia economy.



Transition metal dichalcogenide nanostructures: Synthesis and application in detection and removal of metal ion contaminants from water

Xinyue Xiang, Binqi He, Maiyong Zhu*..... 630

In this article, we mainly review the synthesis and application of two-dimensional transition metal dichalcogenides (TMDs). We detail three main synthesis methods of TMDs: exfoliation, hydrothermal, and CVD, and conduct a comparative analysis of these three methods. Meanwhile, we also provide a detailed analysis of the main applications of TMDs, including their detection and removal of heavy metal ions in aqueous solutions, the desalination of seawater using capacitive deionization technology.



Recent progress of surface/interface modification of transition metal oxides for enhancing electrochemical energy storage and conversion activity

Zhiqiang Cui, Siqi Zhan, Rui Mei, Mengping Liu, Minglei Cao, Qin Wang, Yating Zhao, Rui Tong*, Dongming Cai*, Zhenghui Pan* 699

This review emphasizes the role of surface/interface modification in enhancing TMOs performance, especially in electrochemical energy storage and conversion, guiding future strategy design and optimization.

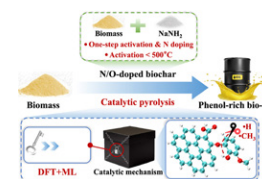


Research papers

Mechanistic insights into the role of N/O-doped biochar in enhanced phenolics production during biomass pyrolysis

Zihang Zhang¹, Honghui Li¹, Jinlong Liu, Jusheng Hu, Shurong Wang* 724

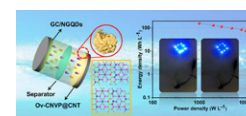
This study employed a single-step NaNH_2 activation method at mild temperatures to synthesize the N/O-doped biochar catalyst for enhanced phenolics production during biomass pyrolysis and combined DFT with machine learning (ML) methods to explore the microscopic catalytic mechanisms.



Enhancing high volumetric energy density of supercapacitors through diatomic reconstruction of layered double hydroxides

Rong Zheng, Lin Sun, Yi Guo, Yu Liu*, Qingjun Yang, Wei Zhang*, Yulong Ying, Weidong Shi*... 736

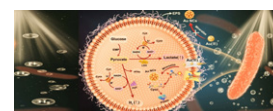
A high-performance hybrid supercapacitor cathode material was developed through dual-atom regulation and synergistic optimization of P-doping and oxygen vacancies.



Clostridium butyricum mineralization of intracellular gold nanoclusters to boost biohydrogen production using visible light

Yaoqiang Wang, Gang Xiao*, Jianmin Xing, Haijia Su* 748

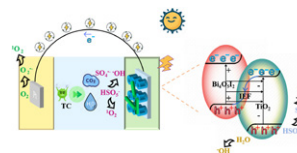
Our work demonstrates a *C. butyricum*-based biohybrid system that mineralizes intracellular gold nanoclusters, and this system achieves highly efficient solar-driven hydrogen production, showcasing a novel strategy for sustainable energy conversion.



Peroxymonosulfate activation on the S-scheme heterojunction $\text{Bi}_4\text{O}_5\text{I}_2/\text{TiO}_2$ photoanode of a photocatalytic fuel cell for degradation of tetracyclines with green power generation

Huizhong Wu, Ruiheng Liang, Yujie Chen, Xiuwu Zhang, Jingyang Liu, Zehua Xia, Ignasi Sirés, Minghua Zhou*..... 760

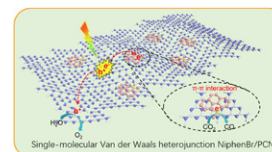
A self-powered PFC system using a $\text{Bi}_4\text{O}_5\text{I}_2/\text{TiO}_2$ S-scheme photoanode and PMS enables efficient organic pollutant degradation and power generation, ROS generation, and light harvesting, offering a promising strategy for sustainable water purification.



Carbon nitride-based single-molecular Van der Waals heterojunction for selective photocatalytic CO_2 reduction to CO

Hongjun Dong, Chunhong Qu, Jiaming Li, Deping Wang, Min Zhang, Zuoyi Liu*, Liqiu Zhang*, Chunmei Li*..... 774

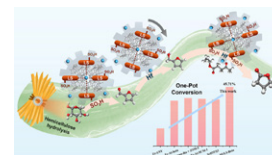
A fresh single-molecular Van der Waals heterojunction NiphenBr/PCN is fabricated through self-assembly technology, dramatically boosting the selective photocatalytic CO_2 reduction performance, the CO evolution rate of which reaches 5.46 and 2.73 times that of PCN and NiphenBr, respectively.



A tunable and universal catalyst for efficient one-pot conversion of xylose to γ -valerolactone

Qiwen Zhan, Ruonan Zhu*, Qingchong Xu, Xingjie Wang, Lihong Zhao, Fengxia Yue, Junli Ren*..... 784

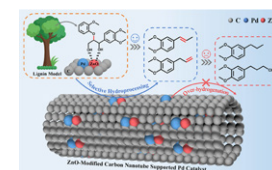
A tailored and versatile catalyst with suitable textural structure and balanced Lewis/Brønsted acidity enables efficient one-pot conversion of xylose to γ -valerolactone (GVL), achieving a high yield of 45.71% surpassing other reported results. Its compatibility with arabinose and glucose further supports a two-step valorization pathway from lignocellulosic biomass to GVL.



Selective hydrogenolysis of lignin to alkene-functionalized monomers over ZnO-modified carbon nanotube supported Pd catalysts

Wen Zhao, Qun Yu*, Bingqing Wei, Lei Nie, Fabio Souza Toniolo, Zhenglong Li*..... 792

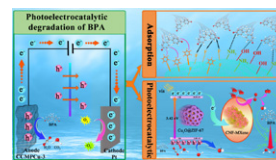
A ZnO-modified carbon nanotubes supported Pd catalyst (Pd/ZnNC) has been designed, demonstrating exceptional selectivity in the selective catalytic hydroprocessing of a lignin model compound into alkene-functionalized monomers, achieving 75% of the theoretical maximum selectivity (50%).



Rigid-flexible dual network hydrogel photoelectrodes for ultrafast and stable catalytic degradation of bisphenol A with minimal metal leaching

Xinmiao Qi, Guoxin Ma, Xiang Xiong, Xin Deng, Ping Jiang, Xin Guo*, Yiqiang Wu..... 805

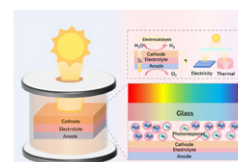
CCMPCu, a chitosan/CNF-MXene/polyaniline hydrogel photoelectrode embedding $\text{Cu}_2\text{O}@\text{ZIF-67}$, pre-concentrates pollutants and enhances charge separation, achieving ~100% BPA removal in 40 min ($k = 0.0836 \text{ min}^{-1}$) under visible light, with <5 ppb Cu leaching over 10 cycles and broad bisphenol applicability.



Heat and hydrogen Co-production based on photoresponsive electrode in the full-spectrum SOEC hybrid system

Chen-Ge Chen, Chenyu Xu*, Guangyu Deng, Jinhao Mei, Shiyao Wu, Entao Zhang, Yanwei Zhang*, Jing-Li Luo..... 822

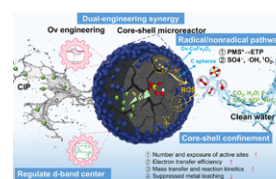
A full-spectrum SOEC system for co-production of heat and hydrogen was introduced. Direct solar irradiation enhances hydrogen output via photocurrent, achieving 58.98% exergy, 28.30% STH, and 43.78% STT efficiency under optimized conditions.



Engineering oxygen vacancy-rich $\text{CoFe}_2\text{O}_4@\text{C}$ core-shell microreactors via defect-morphology dual synergy for ultrafast peroxymonosulfate activation

Long Sui, Zheng-Tao Dong, Yuan Tian, Lei Ma, Cheng-Gang Niu*, Ming Yan, Jia-Jia Wang..... 842

Defect-morphology dual engineering constructs OV- $\text{CoFe}_2\text{O}_4@\text{C}$ core-shell microreactors with four merits: more exposed active sites, enhanced electron transfer, facilitated mass transfer and reaction kinetics, and suppressed metal leaching, achieving 97.65% CIP removal in 12 min ($k_{\text{obs}}=0.2984 \text{ min}^{-1}$).



Tailoring a photoreactive biomass-based redox coupled material for interaction enhanced removal of Cr(VI) and As(III)

Yuanyuan Hu, Jun Mao, Yichun Xue, Zhanlong Tan, Fei Xue, Yuqian Yang, Lei Wang, Hongxiang Zhu*, Hui He*..... 856

The photoreactive biomass-based redox-coupled material constructed from eucalyptus, polyethyleneimine, porous carbon, and iron oxide, which can adsorb highly toxic Cr(VI) and As(III) and convert them with >95% efficiency into less toxic species, enabling comprehensive water purification.

