

Front Cover

Cell-free biocatalysis coupled with photo-catalysis and electro-catalysis: Efficient CO₂-to-chemical conversion

Junzhu Yang¹, Chi-Kit Sou¹, Yuan Lu*

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Research highlight

CO₂ electrolysis to formic acid for carbon neutralization

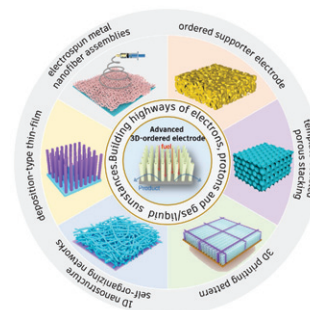
Kezhen Qi, Shu-yuan Liu*, Yingjie Zhang*, Hui Zhang*, Vadim Popkov, Oksana Almjashaeva..... 1333

Review articles

Advanced 3D ordered electrodes for PEMFC applications: From structural features and fabrication methods to the controllable design of catalyst layers

Kaili Wang, Tingting Zhou, Zhen Cao, Zhimin Yuan, Hongyan He*, Maohong Fan*, Zaiyong Jiang*..... 1366

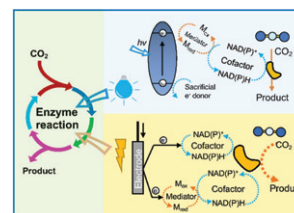
A 3D ordered electrode with self-supporting architecture while reducing noble metal Pt loadings is capable of achieving ability and durability targets for the MEA in PEMFCs. In this review, we discussed the motivation in depth and summarized the necessary CL structural features in designing ultralow Pt loading for PEMFCs. The critical issues that remain in progress for 3D ordered CLs also studied. Moreover, we summarized emphatically the fabrication method for the development of 3D ordered CL electrode expected to be implemented in next-generation electrodes for PEMFCs.



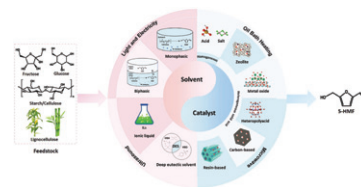
Cell-free biocatalysis coupled with photo-catalysis and electro-catalysis: Efficient CO₂-to-chemical conversion

Junzhu Yang¹, Chi-Kit Sou¹, Yuan Lu*..... 1366

This work summarized the progress of photoenzyme catalysis, electroenzyme catalysis, and photo-electroenzyme catalysis for the conversion of carbon dioxide into chemical products in cell-free system, and discussed the challenges and prospects of coupling physical signals and cell-free enzymatic catalytic systems in the field of CO₂ fixation in the future.



This review described the latest advanced research on solvent and catalyst system, as well as energy field effect for production of 5-HMF with different feedstock, and the future prospects and challenges for production of 5-HMF from carbohydrates were discussed.

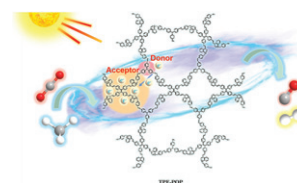


Research papers

A novel metal-free porous covalent organic polymer for efficient room-temperature photocatalytic CO₂ reduction via dry-reforming of methane

Sheng-Yan Yin¹, Ziyi Li¹, Yingcai Hu, Xiao Luo*, Jishan Li* 1407

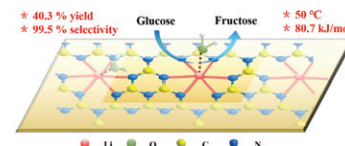
As a metal-free covalent organic photocatalyst, TPE-COP possesses electron donor-acceptor pairs and high CO₂/CH₄ gas adsorption capacity, and is driven by visible light to effectively initiate dry-reforming of methane at room temperature.



Li-promoted C₃N₄ catalyst for efficient isomerization of glucose into fructose at 50 °C in water

Wang Liu¹, Yanfei Zhang¹, Mengya Sun, Xinpeng Zhao, Shenggang Li, Xinqing Chen*, Liangshu Zhong*, Lingzhao Kong* 1419

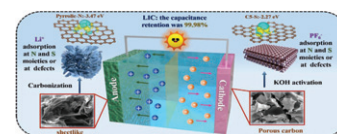
A Li-promoted C₃N₄ catalyst was exploited which afforded an excellent fructose yield (40.3 wt%) and selectivity (99.5%) from glucose in water at 50 °C, which is attributed to strengthened basic sites and so-formed N₆-Li-H₂O active site in aqueous phase.



Furfural residues derived nitrogen-sulfur co-doped sheet-like carbon: An excellent electrode for dual carbon lithium-ion capacitors

Xiaoying Guo, Yan Qiao, Zonglin Yi, Christian Marcus Pedersen, Yingxiong Wang*, Xiaodong Tian*, Peide Han* 1427

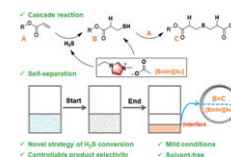
A straightforward strategy for the commercial large-scale production of heteroatom-doped porous carbon materials was provided and promotes the development of biomass based high-energy-density devices.



Self-separation ionic liquid catalyst for the highly effective conversion of H₂S by α,β-unsaturated carboxylate esters under mild conditions

Wenjia Xiong, Xiaomin Zhang*, Xingbang Hu, Youting Wu* 1440

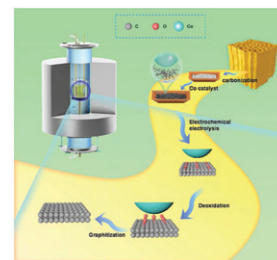
This work develops a novel methodology for the highly efficient conversion of H₂S by α,β-unsaturated carboxylate esters mediated in carboxylate-based ILs and self-separation of catalysts and products is unexpectedly realized.



Low-temperature graphitization of lignin via Co-assisted electrolysis in molten salt

Shijie Li, Wei-Li Song*, Xue Han, Qingqing Cui, Yan-li Zhu*, Shuqiang Jiao..... 1449

In this paper, an efficient and environmentally friendly electrochemical conversion technology is proposed to prepare highly graphitized carbon materials using abundant natural resource lignin. The preparation process mainly consists of pyrolytic carbonization of raw materials and electrochemical conversion of amorphous carbon precursors. The graphitization of the products was significantly increased with the assistance of Co catalyst.



Nitrogen-doping boosts *CO utilization and H₂O activation on copper for improving CO₂ reduction to C₂₊ products

Yisen Yang, Zhonghao Tan, Jianling Zhang*, Jie Yang, Renjie Zhang, Sha Wang, Yi Song, Zhuizhui Su..... 1459

N-doped Cu exhibited remarkable efficiency in the electrocatalytic conversion of CO₂-to-C₂₊ products. At a high current density of 0.85 A cm⁻², the Faradaic efficiency of C₂₊ products reached 72.7%. This exceptional catalyst performance can primarily come from the improved *CO utilization and H₂O activation by N doping.



Piezoelectric-enhanced n-TiO₂/BaTiO₃/p-TiO₂ heterojunction for highly efficient photoelectrocatalysis

Minhua Ai, Zihang Peng, Xidi Li, Faryal Idrees, Xiangwen Zhang, Ji-Jun Zou, Lun Pan*..... 1466

A new n-TiO₂/BaTiO₃/p-TiO₂ heterojunction that couples with piezoelectric effect and p-n junction has been developed. This heterojunction can provide a strong driving force to accelerate carrier separation and achieve piezoelectric-enhanced photoelectrochemical performance. This work provides a piezoelectric polarization strategy for modulating the built-in electric field of heterojunction for photoelectrochemical system.



Low-temperature chemistry in plasma-driven ammonia oxidative pyrolysis

Mingming Zhang, Qi Chen*, Guangzhao Zhou, Jintao Sun, He Lin..... 1477

DBD flow reactor is used to study the kinetic process of ammonia pyrolysis and oxidation assisted by NSD plasma at low temperature and low pressure. The kinetic models of plasma-assisted NH₃ oxidative pyrolysis are established.

