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Suzuki cross-coupling reactions over engineered AuPd alloy nanoparticles by recycling scattered light

Homogeneous nitrogen-doped (111)-type layered $Sr_5Nb_4O_{15-x}N_x$ as a visible-light-responsive photocatalyst for water oxidation

Recent advances in nature-inspired nanocatalytic reduction of organic molecules with water

Young Innovators Awards in NanoCatalysis 2022

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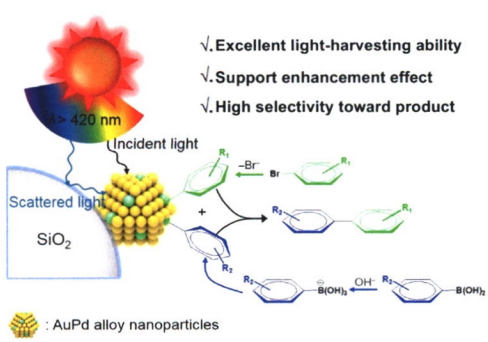
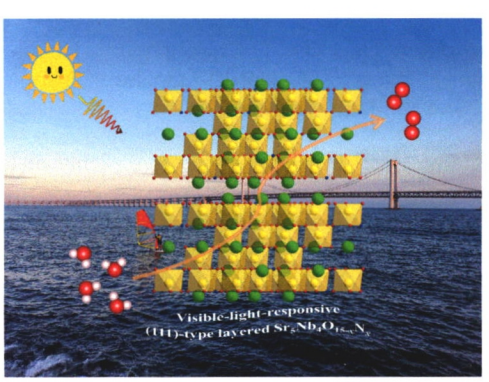
Editorial



By means of using both incident and scattered photons based on the near-field scattering light-promoted optical absorption model, AuPd alloy nanoparticles have been rationally engineered by loading onto the spherical SiO_2 support to improve their light-harvesting capability toward photocatalytic Suzuki cross-coupling synthesis.



Novel homogeneous nitrogen-doped (111)-type layered perovskite oxynitride ($Sr_5Nb_4O_{15-x}N_x$) is directly synthesized using a thermal ammonolysis method, which exhibits an enhanced photocatalytic oxygen (O_2) evolution activity from water splitting under visible-light illumination (λ > 420 nm) after loading with cobalt oxide (CoO_x) as cocatalyst.

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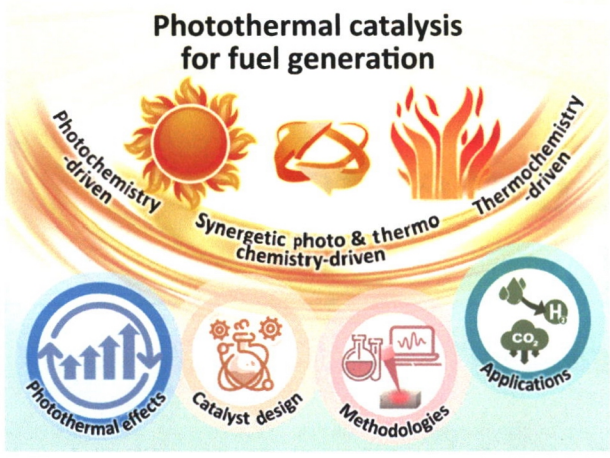
Advances of photothermal chemistry in photocatalysis, thermocatalysis, and synergetic photothermocatalysis for solar-to-fuel generation

Minmin Gao[1], Tianxi Zhang[1], and Ghim Wei Ho[1,2,*]

[1] National University of Singapore, Singapore
[2] Institute of Materials Research and Engineering, Agency for Science, Technology and Research (A*STAR), Singapore

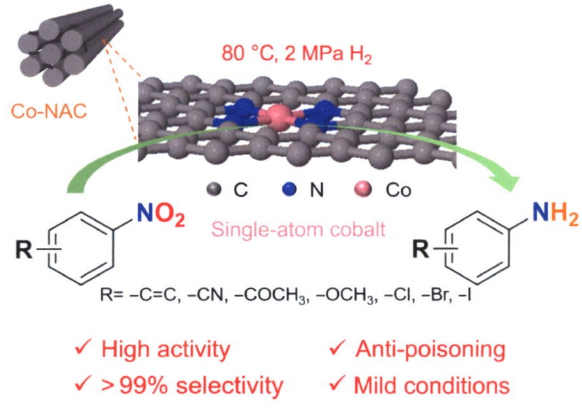


This article aims to provide a comprehensive review of the benefits of photothermal catalysis for fuel generation, along with a guide for understanding its mechanisms, rational material designs, characterization techniques and current applications.

Highly efficient and anti-poisoning single-atom cobalt catalyst for selective hydrogenation of nitroarenes

Yuemin Lin[1], Renfeng Nie[3], Yuting Li[2], Xun Wu[2], Jiaqi Yu[2], Shaohua Xie[4], Yajing Shen[1,5], Shanjun Mao[4], Yuzhuo Chen[4], Dan Lu[1], Zongbi Bao[1,5], Qiwei Yang[1,5], Qilong Ren[1,5], Yiwen Yang[1,5], Fudong Liu[4], Long Qi[2,*], Wenyu Huang[3,*], and Zhiguo Zhang[1,5,*]

[1] Zhejiang University, China
[2] Iowa State University, USA
[3] Zhengzhou University, China
[4] University of Central Florida, USA
[5] Institute of Zhejiang University-Quzhou, China

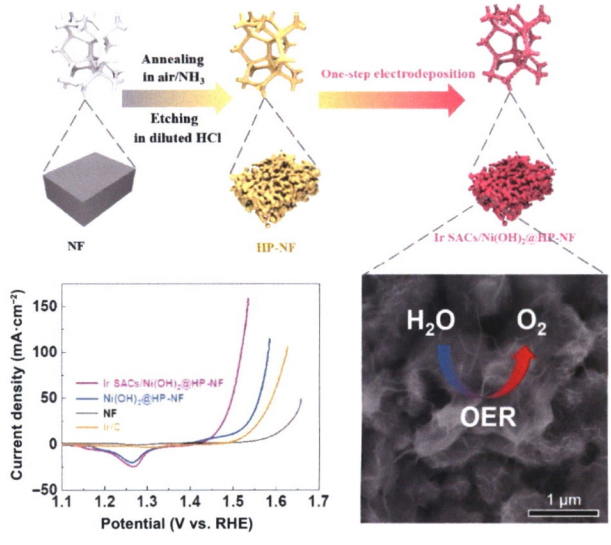


A novel single-atom cobalt catalyst (Co-NAC) was developed to selectively reduce functionalized nitroarenes to corresponding amines under mild conditions. Co-NAC catalyst affords high activity, > 99% selectivity and superior resistance towards sulfur-containing poisons (20 equivalents), showing great potential in the chemical industry.

Ir single atoms modified $Ni(OH)_2$ nanosheets on hierarchical porous nickel foam for efficient oxygen evolution

Chunxu Jia[1,2], Hao Qin[1,2], Chao Zhen[1,*], Huaze Zhu[1,2], Yongqiang Yang[1], Ali Han[1], Lianzhou Wang[3], Gang Liu[1,2,*], and Hui-Ming Cheng[1,4]

[1] Institute of Metal Research, Chinese Academy of Sciences, China
[2] University of Science and Technology of China, China
[3] The University of Queensland, Australia
[4] Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences, China

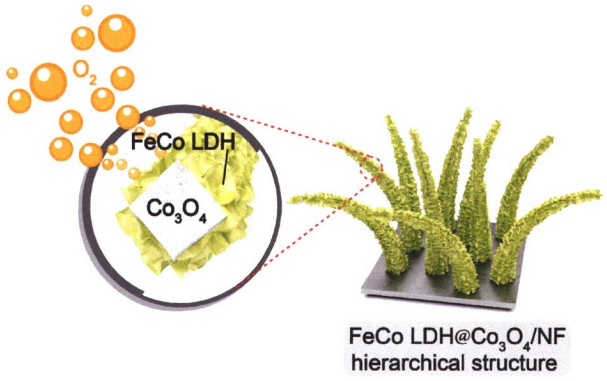


A feasible one-step electrodeposition method was developed to fabricate Ir single atoms modified $Ni(OH)_2$ nanosheets on a hierarchical porous nickel substrate as oxygen evolution reaction (OER) electrode for efficient electrochemical water splitting.

Constructing hierarchical nanosheet-on-microwire FeCo LDH@Co_3O_4 arrays for high-rate water oxidation

Tang Tang[1,2], Zhe Jiang[1,2], Jun Deng[3], Shuai Niu[1,2], Ze-Cheng Yao[1,2], Wen-Jie Jiang[1], Lin-Juan Zhang[4,5], and Jin-Song Hu[1,2,5,*]

[1] Institute of Chemistry, Chinese Academy of Sciences, China
[2] University of the Chinese Academy of Sciences, China
[3] Institute of Physics, Chinese Academy of Sciences, China
[4] Shanghai Institute of Applied Physics, Chinese Academy of Sciences, China
[5] Dalian National Laboratory for Clean Energy, China

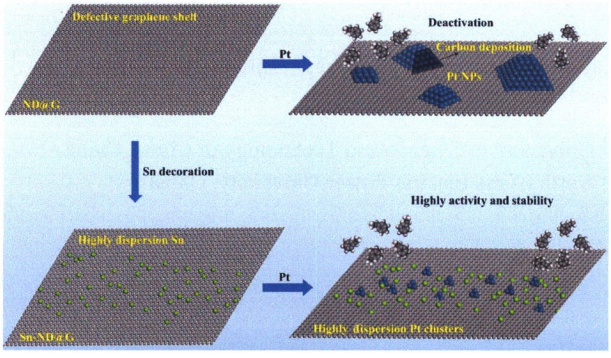


A Fe^{3+} induced nanosizing strategy is developed to fabricate hierarchical nanosheet-on-microwire FeCo LDH@Co_3O_4 (LDH: layered double hydroxide) electrocatalysts with abundant highly-active and durable catalytic sites for high-rate water oxidation. It demonstrates an oxygen evolution reaction (OER) current density of 1,000 mA·cm^{-2} at a small overpotential of 392 mV.

Fully-exposed Pt clusters stabilized on Sn-decorated nanodiamond/graphene hybrid support for efficient ethylbenzene direct dehydrogenation

Linlin Wang[1,2], Xuetao Qin[3], Ting Sun[1,*], Xiangbin Cai[4], Mi Peng[3], Zhimin Jia[2,5], Xiaowen Chen[2,5], Ning Wang[4], Jiangyong Diao[2,*], Hongyang Liu[2,5,*], and Ding Ma[3]

[1] Northeastern University, China
[2] Institute of Metal Research, Chinese Academy of Sciences, China
[3] Peking University, China
[4] Hong Kong University of Science and Technology, Hong Kong, China
[5] University of Science and Technology of China, China

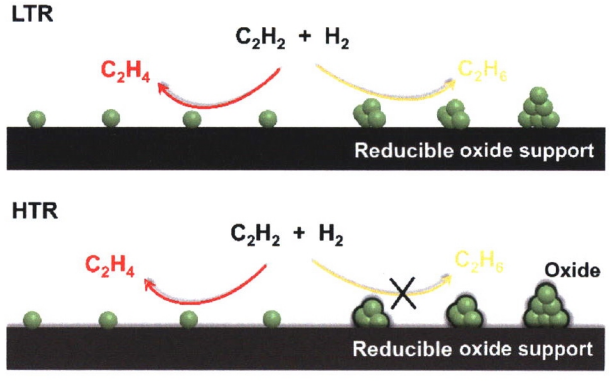


The fully-exposed Pt clusters were fabricated on the Sn-decorated nanodiamond/graphene (Pt/Sn-ND@G) hybrid support, and exhibited higher yields and better stability in the direct dehydrogenation of ethylbenzene to styrene, in comparison with the typical Pt nanoparticles.

Pd single-atom catalysts derived from strong metal–support interaction for selective hydrogenation of acetylene

Yalin Guo[1,2], Yangyang Li[1,2], Xiaorui Du[3], Lin Li[1], Qike Jiang[1,*], and Botao Qiao[1,*]

[1] Dalian Institute of Chemical Physics, Chinese Academy of Sciences, China
[2] University of Chinese Academy of Sciences, China
[3] Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences, China

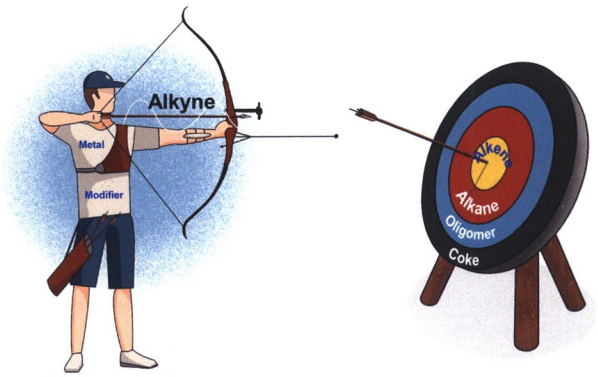


Pd single-atom catalysts (SACs) were fabricated by a simple strategy, reducing supported Pd catalysts at suitable temperatures to selectively encapsulate the co-existed Pd nanoparticles (NPs)/clusters, which exhibit much higher selectivity and stability in semi-hydrogenation of acetylene.

Fundamental aspects of alkyne semi-hydrogenation over heterogeneous catalysts

Zhe Wang, Qian Luo, Shanjun Mao, Chunpeng Wang, Jinqi Xiong, Zhirong Chen, and Yong Wang*

Zhejiang University, China

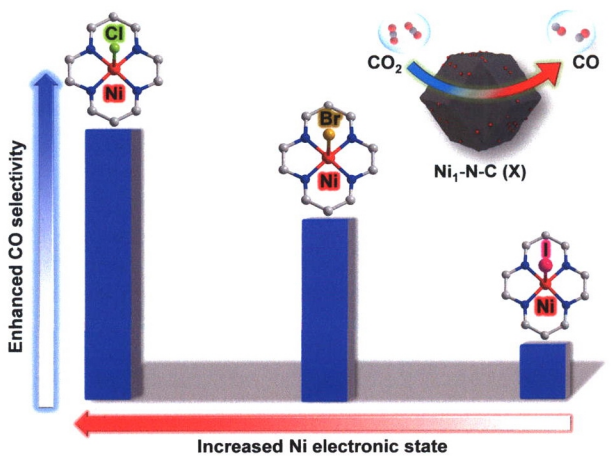


A fundamental viewpoint about how to acquire alkenes with high efficiency in alkyne hydrogenation was provided.

Axial coordination regulation of MOF-based single-atom Ni catalysts by halogen atoms for enhanced CO_2 electroreduction

Jia-Xin Peng[1], Weijie Yang[2], Zhenhe Jia[2], Long Jiao[1,*], and Hai-Long Jiang[1,*]

[1] University of Science and Technology of China, China
[2] North China Electric Power University, China

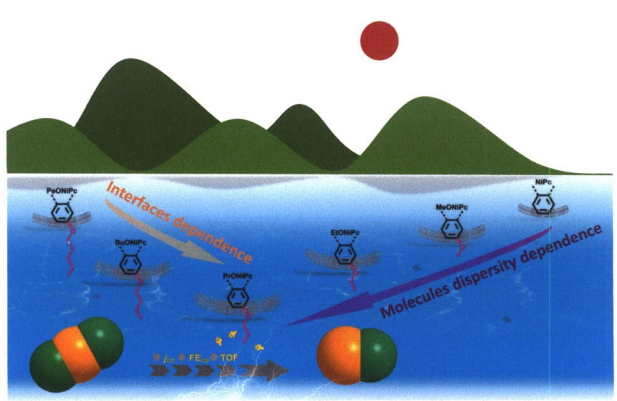


A series of single-atom Ni catalysts with different axial coordination halogen atoms are successfully constructed. They demonstrate enhanced CO selectivity with the increase of Ni electronic states regulated by the halogen species in electrocatalytic CO_2 reduction.

Surveying the electrocatalytic CO_2-to-CO activity of heterogenized metallomacrocycles via accurate clipping at the molecular level

Meng-Ke Hu[1,2], Ning Wang[1,2], Dong-Dong Ma[1,*], and Qi-Long Zhu[1,2,3,*]

[1] Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences, China
[2] Fuzhou University, China
[3] Fujian Science & Technology Innovation Laboratory for Optoelectronic Information of China, China

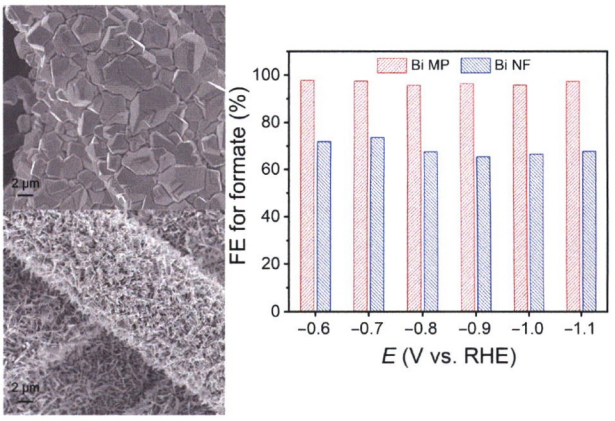


The alkyl chains of immobilized nickel phthalocyanines regulate the dispersibility and heterointerfaces and thus the electrocatalytic CO_2-to-CO activity with a volcano-type trend.

Electrodeposited highly-oriented bismuth microparticles for efficient CO_2 electroreduction into formate

Chen Lin, Yan Liu, Xiangdong Kong, Zhigang Geng*, and Jie Zeng*

University of Science and Technology of China, China

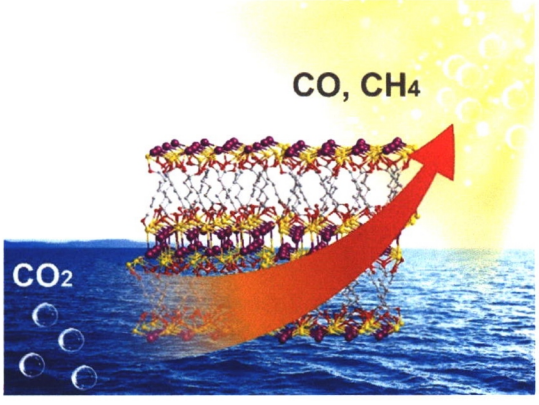


While Bi microparticles (MP) possess lower specific surface area than Bi nanoflakes (NF), Bi MP exhibited better catalytic performance. The different exposed surfaces lead to such results.

A water-stable organolead iodide material for overall photocatalytic CO_2 reduction

Rong Chen, Guodong Gao, and Jingshan Luo*

Nankai University, China

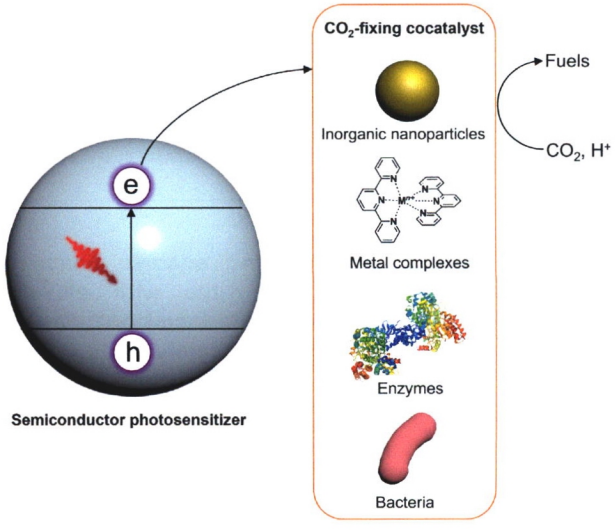


The 0.19 wt.‰ Au nanoparticles mediated water-stable perovskite-like organolead iodide crystalline material ($[Pb_8I_8(H_2O)_3]^{8+}[^-O_2C(CH_2)_4CO_2^-]_4$) (TJU-16) exhibited photocatalytic CO and CH_4 production rate of 2.5 and 10.1 $\mu mol \cdot g^{-1} \cdot h^{-1}$ respectively in water under AM 1.5G simulated illumination for photocatalytic CO_2 reduction without sacrificial reagent, and achieved a solar-to-fuel conversion efficiency of 0.034%.

Advances and challenges in developing cocatalysts for photocatalytic conversion of carbon dioxide to fuels

Qian Wang[1,*] and Zhenhua Pan[2]

[1] Nagoya University, Japan
[2] Chuo University, Japan

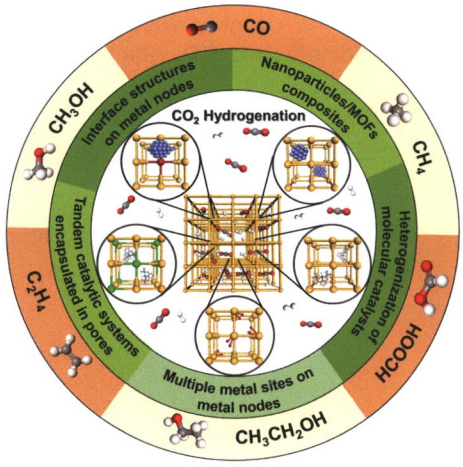


Heterogeneous solar fuel production systems are multi-component, comprising photosensitizer and catalytic unit, which is termed "cocatalyst". This review presents a comprehensive summary of the recent advancements in cocatalysts for photocatalytic CO_2 reduction to provide new insights and guidance to the field with regard to research directions and best practices.

Recent advances in metal-organic frameworks for catalytic CO_2 hydrogenation to diverse products

Shengxian Shao[1,2], Chengqian Cui[1,2], Zhiyong Tang[1,2], and Guodong Li[1,2,*]

[1] National Center for Nanoscience and Technology, China
[2] University of Chinese Academy of Sciences, China

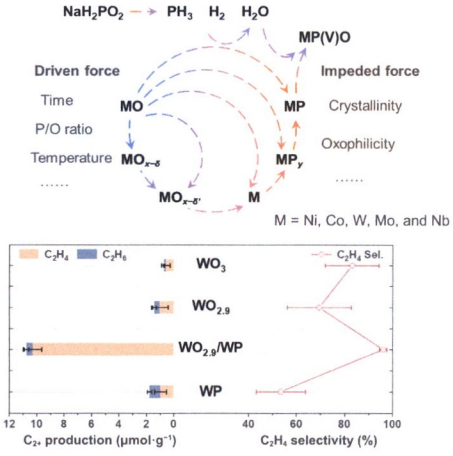


With the well-defined reticular frameworks and flexible modifiability, metal-organic frameworks (MOFs) can be the ideal platform to construct the enabled catalysts for CO_2 hydrogenation with the enhancement of catalytic activity and precise control of selectivity. In this review, we systematically summarize the recent advances on MOFs based catalysts for selective CO_2 hydrogenation towards diverse products.

Mechanistic insight into the controlled synthesis of metal phosphide catalysts from annealing of metal oxides with sodium hypophosphite

Fanpeng Chen, Bohang Zhao, Mengyao Sun, Cuibo Liu, Yanmei Shi, Yifu Yu, and Bin Zhang*

Tianjin University, China

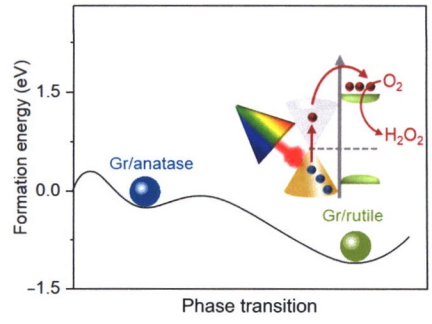


The antagonism of the driven and impeded forces (time, P/O ratio, temperature, crystallinity, and oxophilicity) is reported to determine the composition of various products (e.g., metal oxide (MO), $MO_{x-\delta}$, $MO_{x-\delta}$–MP_y, MP_y, MP, and MPO) for the phosphorization synthesis of metal oxides. As a proof-of-concept application, the as-synthesized $WO_{2.9}$/WP exhibits greatly improved photocatalytic oxidative performance toward the coupling of methane, outperforming WO_3, $WO_{2.9}$, and WP counterparts.

Rapidly and mildly transferring anatase phase of graphene-activated TiO_2 to rutile with elevated Schottky barrier: Facilitating interfacial hot electron injection for Vis–NIR driven photocatalysis

Weiyao Hu[1], Qiyuan Li[1], Dong Xu[1], Guangyao Zhai[1], Shinan Zhang[1], Dong Li[2], Xiaoxiao He[2], Jinping Jia[1], Jiesheng Chen[1], and Xinhao Li[1,*]

[1] Shanghai Jiao Tong University, China
[2] East China Normal University, China

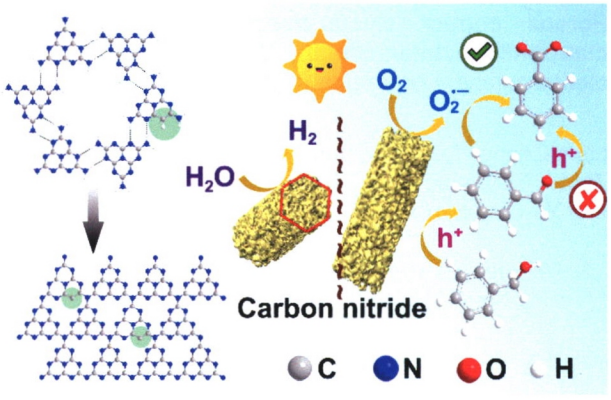


We developed a mild but fast phase transfer method for the synthesis of graphene/rutile heterojunctions to promote the hot electron injected at the interface and final H_2O_2 production under visible–near infrared ray (Vis–NIR) light irradiation.

Aromatic alcohols oxidation and hydrogen evolution over π-electron conjugated porous carbon nitride rods

Jiawei Xia[1,2], Neeta Karjule[2], Gabriel Mark[2], Michael Volokh[2], Haiqun Chen[1], and Menny Shalom[2,*]

[1] Changzhou University, China
[2] Ben-Gurion University of the Negev, Israel



Melem and a co-monomer (carbon-rich substituted melem) construct a supramolecular assembly to synthesize carbon-doped porous carbon nitride (CN) rods with extended π-electron conjugation. The optimal CN material shows excellent photocatalytic activity towards hydrogen evolution reaction via water splitting and selective oxidation reaction of aromatic alcohols.

Shedding light on the role of interfacial chemical bond in heterojunction photocatalysis

Yueshuang Mao[1], Pengfei Wang[2,*], and Sihui Zhan[1,*]

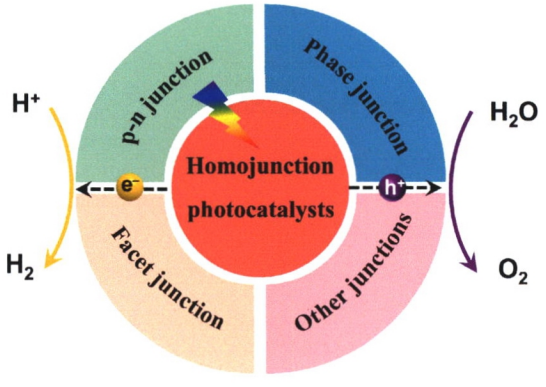
[1] Nankai University, China
[2] Hebei University of Technology, China

Interfacial chemical bonds act as specific "bridge" for reducing the electron transfer distance and driving interfacial charge transfer directionally in heterojunction photocatalysis. This article reviewed the design strategies, characterization techniques, applications and the future perspectives for interfacial chemical bonds.

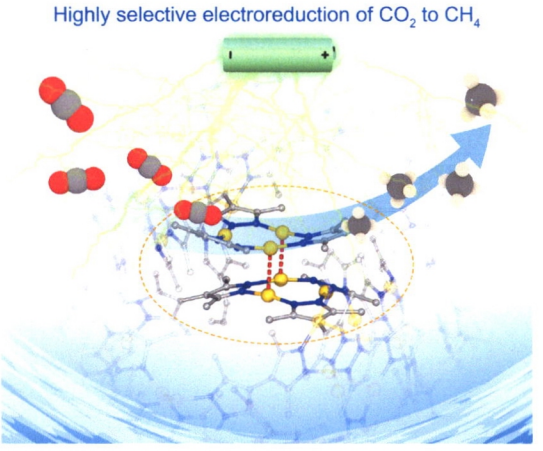
Homojunction photocatalysts for water splitting

Xiangjiu Guan[1,2], Shichao Zong[3], and Shaohua Shen[1,*]

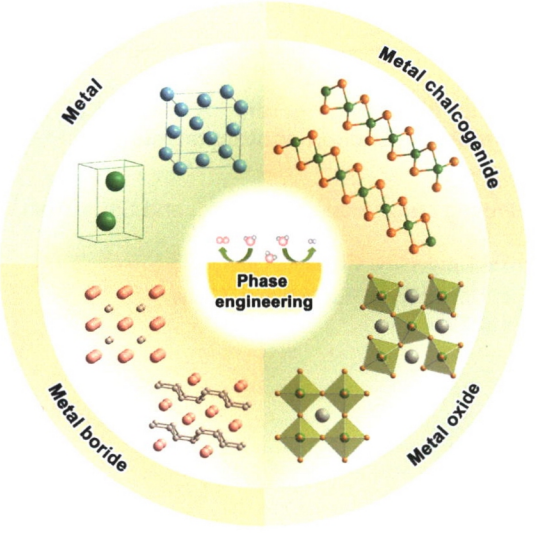
[1] Xi'an Jiaotong University, China
[2] Suzhou Academy of Xi'an Jiaotong University, China
[3] Chang'an University, China



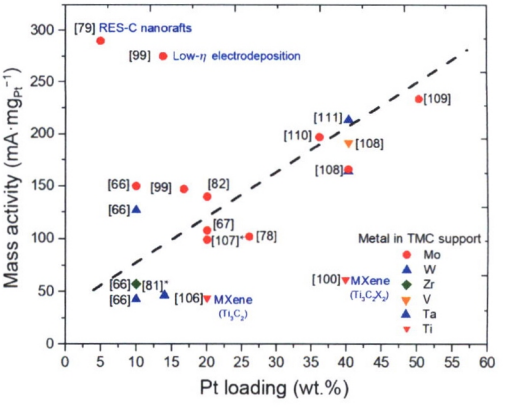
Methods for the construction of homojunction-based photocatalyst and the recent progress in water splitting are summarized and discussed.



A copper cluster-based metal-organic framework (MOF) stabilized by cuprophilic interactions was constructed and utilized for highly efficient electrocatalytic CO_2 reduction to CH_4 in a gas diffusion flow cell. The high faradaic efficiencies can be attributed to the favorable combination of the pore channel and the enhanced cuprophilic interactions.



Theoretical and experimental advances made in phase engineering of electrocatalysts are summarized. Basic understanding on crystal phases and phase-controlled synthesis of electrocatalysts are introduced. Phase-activity relationship in different kinds of electrocatalysts and future directions of phase design are discussed.

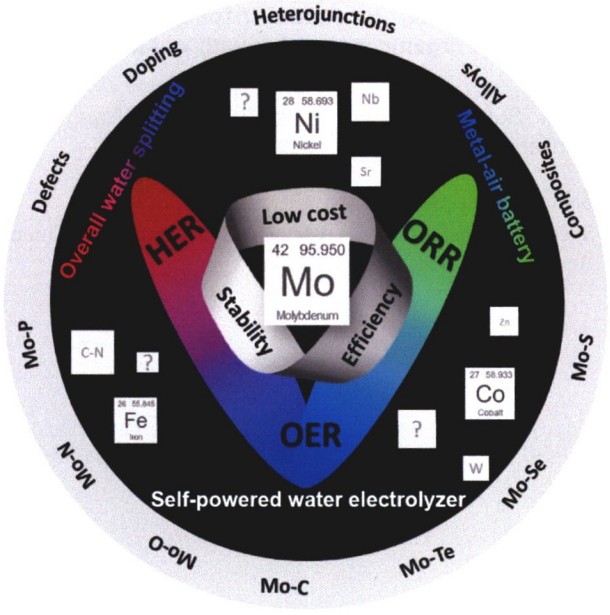


This review provides an overview of progress towards improving the activity and durability of transition metal carbides as catalyst supports for the cathode of proton exchange membrane fuel cells.

Emerging noble metal-free Mo-based bifunctional catalysts for electrochemical energy conversion

Saswati Santra, Verena Streibel, and Ian D. Sharp*

Technical University of Munich, Germany

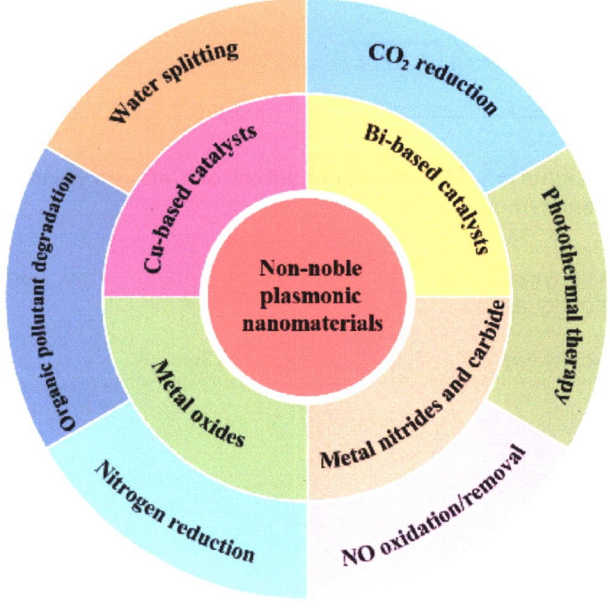


Molybdenum-based systems are attracting considerable interest as bifunctional electrocatalysts capable of supporting hydrogen evolution reaction/oxygen evolution reaction (HER/OER) and oxygen reduction reaction (ORR)/OER for application in overall water splitting cells and metal-air batteries. This article reviews and analyses the progress and future prospects for this versatile class of Mo-based catalytic compounds, composites, and heterostructures. The strategies and mechanisms underlying these achievements can support the development of a next generation of sustainable, scalable, and efficient noble metal-free electrocatalysts.

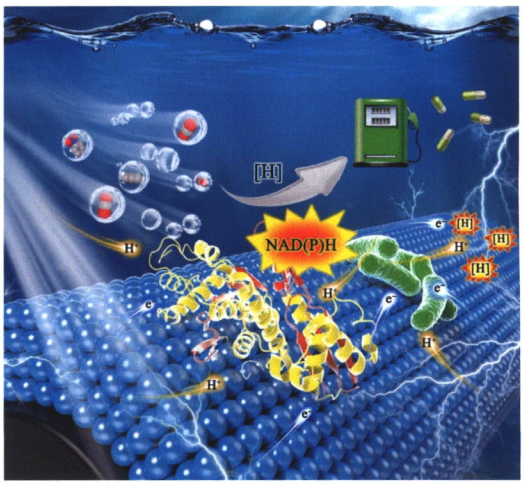
Noble-metal free plasmonic nanomaterials for enhanced photocatalytic applications—A review

Jinghua Li[1], Yiming Zhang[1], Yalong Huang[1], BingLuo [2], Li Jing[1], and Dengwei Jing[1,*]

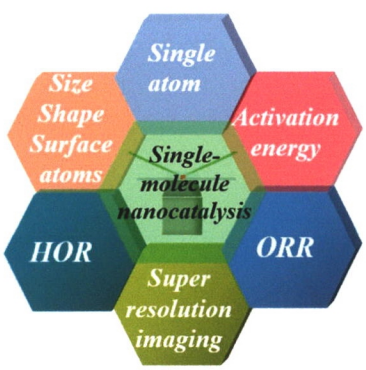
Xi'an Jiaotong University, China



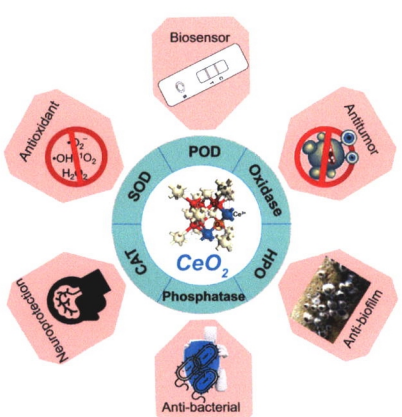
This paper reviews the fundamental principles and classification of the localized surface plasmon resonance (LSPR) effect of noble-metal free plasmonic nanomaterials in photocatalytic and their recent applications in hydrogen generation, carbon dioxide reduction, and pollutant degradation.



In the presence of nanocatalysts, the proton or the water can be reduced by the photocatalytically or electrocatalytically generated electrons to furnish reactive hydrogen species [H]s, which function in the form of powerful reducing equivalents (NAD(P)H, etc.) in semi-artificial systems. These reactive hydrogen species can efficiently assist the reduction of CO_2 or organic molecules to synthesize green liquid fuels, and fine chemicals and pharmaceuticals.



It is critical to investigate the catalytic activity of individual nanoparticles using *in situ* techniques. This review summarizes recent reviews in studying the catalytic behavior of nanoparticles at the single-particle level.

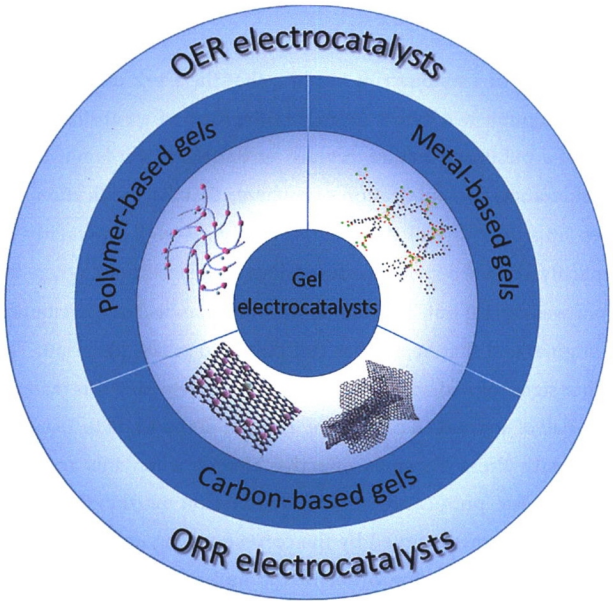


Defective CeO_2 nanocatalysts exhibit multiple enzyme-like activities, which are highly correlated to the reversible Ce^{3+}/Ce^{4+} redox pair. Understanding catalytic mechanism under the catalytic conditions at molecular/electronic levels paves the way for their practical utilizations for disease diagnosis and treatments. This review focuses on the recent progress of catalytic mechanisms of CeO_2-based nanozymes and presents the perspectives on this rapidly developing area.

Progress on nanostructured gel catalysts for oxygen electrocatalysis

Huan Yang[1], Huilin Hu[1], Chenfeng Xia[2], Feng You[1], Junlong Yao[1], Xueliang Jiang[1,*], and Bao Yu Xia[2,*]

[1] Wuhan Institute of Technology, China
[2] Huazhong University of Science and Technology, China

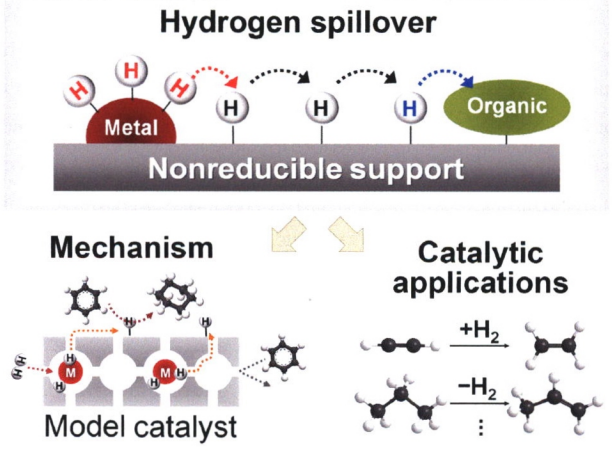


Based on the structure–activity–performance relationship of nanostructured gel materials, the development and application of polymer-based gels, metal-based gels and carbon-based gels as oxygen evolution reaction (OER)/oxygen reduction reaction (ORR) electrocatalysts are discussed and summarized.

Hydrogen spillover in nonreducible oxides: Mechanism and catalytic utilization

Songhyun Lee[1,†], Hyungjun Kim[1], Ryong Ryoo[1,2], Jeong Young Park[1,3], and Minkee Choi[1,*]

[1] Korea Advanced Institute of Science and Technology, Republic of Korea
[2] Korea Institute of Energy Technology (KENTECH), Republic of Korea
[3] Institute for Basic Science (IBS), Republic of Korea
[†] Present address: Purdue University, USA



Mechanism of hydrogen (H) spillover in nonreducible oxides and the opportunities of harnessing H spillover for designing advanced hydroprocessing catalysts are discussed.

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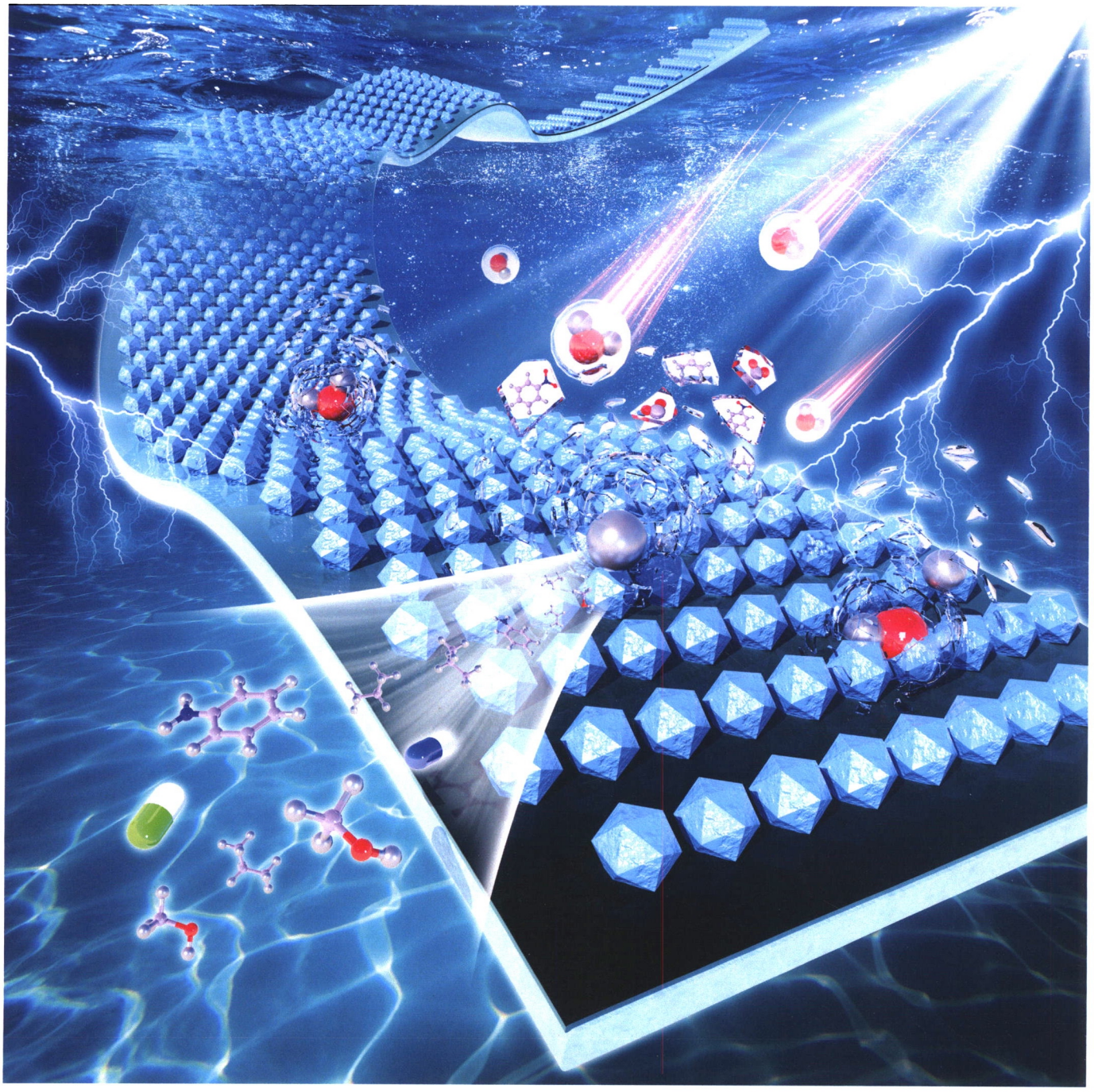

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