



Chinese Journal of Catalysis

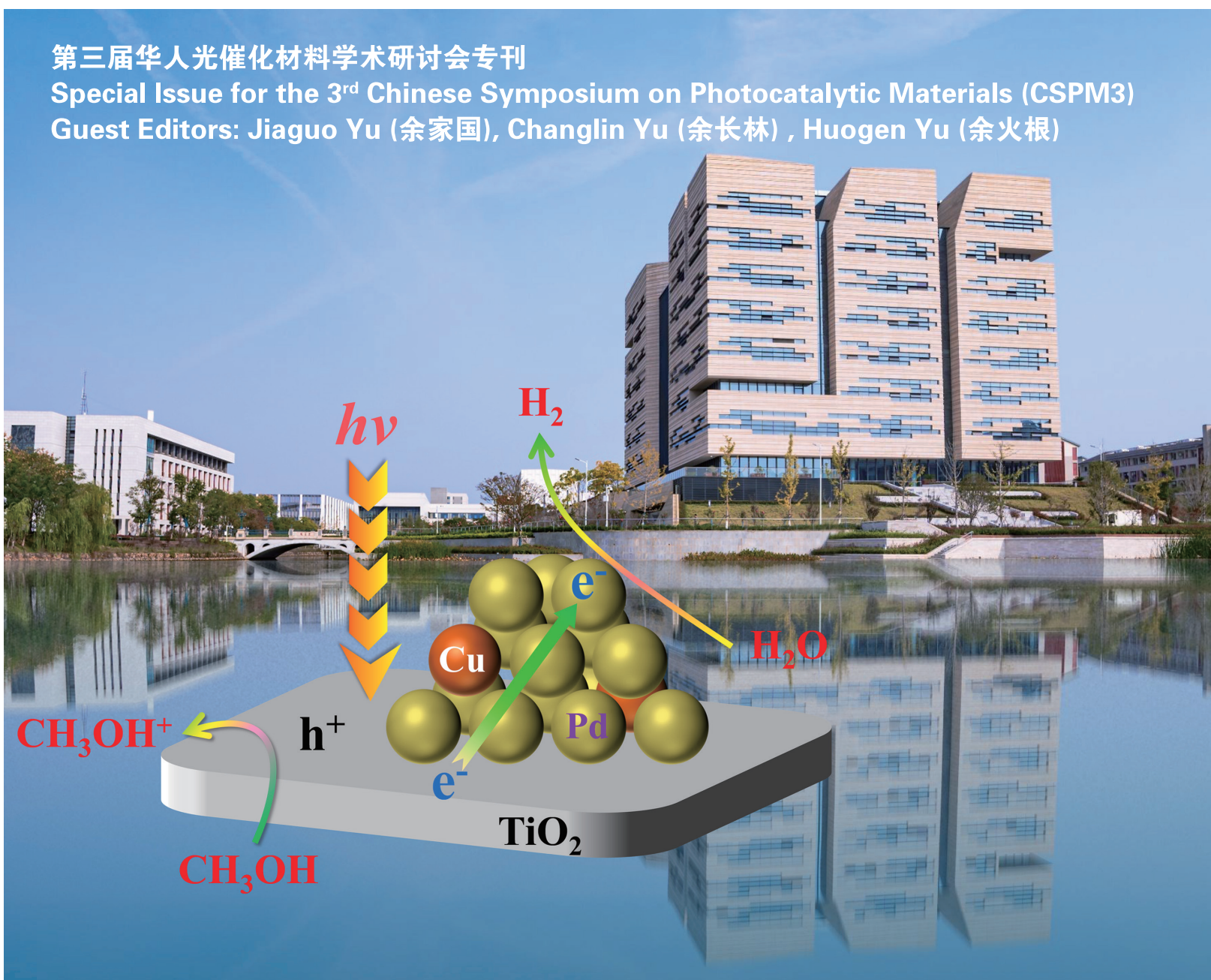
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第三届华人光催化材料学术研讨会专刊

Special Issue for the 3rd Chinese Symposium on Photocatalytic Materials (CSPM3)

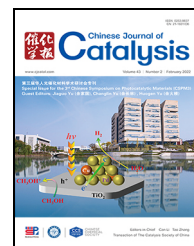
Guest Editors: Jiaguo Yu (余家国), Changlin Yu (余长林), Huogen Yu (余火根)



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Special Issue for the 3rd Chinese Symposium on Photocatalytic Materials (CSPM3)

Guest Editors: Jiaguo Yu (余家国), Changlin Yu (余长林), Huogen Yu (余火根)

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Graphical Contents

Editorial

Chin. J. Catal., 2022, 43: 177 doi: 10.1016/S1872-2067(21)63971-2

Preface to special issue for the 3rd Chinese Symposium on Photocatalytic Materials (CSPM3)

Jiaguo Yu, Changlin Yu, Huogen Yu

China University of Geosciences; Guangdong University of Petrochemical Technology



Review

Chin. J. Catal., 2022, 43: 178–214 doi: 10.1016/S1872-2067(21)63910-4

A review on heterogeneous photocatalysis for environmental remediation: From semiconductors to modification strategies

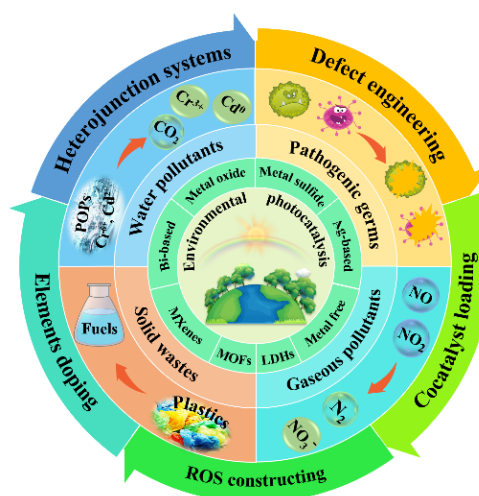
Huijie Wang, Xin Li, Xiaoxue Zhao, Chunyan Li, Xianghai Song,

Peng Zhang, Pengwei Huo *, Xin Li *

Jiangsu University; Zhengzhou University;

South China Agricultural University

Herein, the fundamentals of heterogeneous photocatalysis in the environmental remediation of several pollutants, including H₂O pollutants, pathogenic microorganisms, gaseous pollutants, and solid wastes, are discussed. In addition, potential semiconductors and their modification strategies are systematically addressed. Furthermore, future developments are prospected.



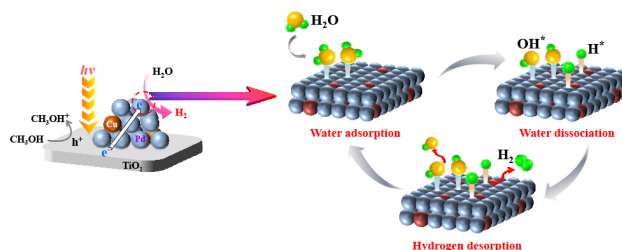
Articles

Chin. J. Catal., 2022, 43: 215–225 doi: 10.1016/S1872-2067(21)63830-5

Palladium-copper nanodot as novel H₂-evolution cocatalyst: Optimizing interfacial hydrogen desorption for highly efficient photocatalytic activity

Jiachao Xu, Duoduo Gao, Huogen Yu*, Ping Wang, Bichen Zhu, Linxi Wang*, Jiajie Fan
Wuhan University of Technology; China University of Geosciences; Zhengzhou University

Transition metal Cu was successfully introduced into the metallic Pd to optimize the strength of palladium-hydrogen bond (Pd-H) through Pd-Cu alloying effect to obtain the excellent H₂-evolution performance.

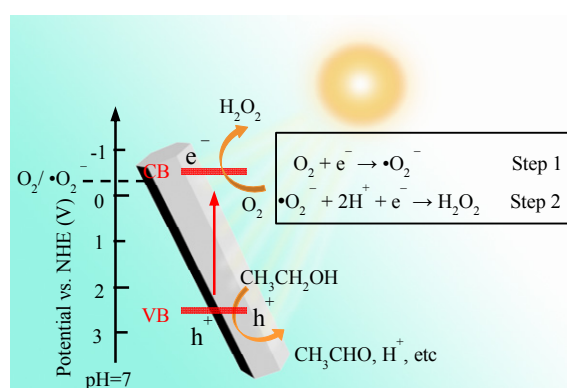


Chin. J. Catal., 2022, 43: 226–233 doi: 10.1016/S1872-2067(21)63832-9

Effect of calcination temperatures on photocatalytic H₂O₂-production activity of ZnO nanorods

Zicong Jiang, Yong Zhang, Liuyang Zhang*, Bei Cheng*, Linxi Wang
Wuhan University of Technology; Foshan Xianhu Laboratory of the Advanced Energy Science and Technology Guangdong Laboratory; Hubei Polytechnic University; China University of Geosciences

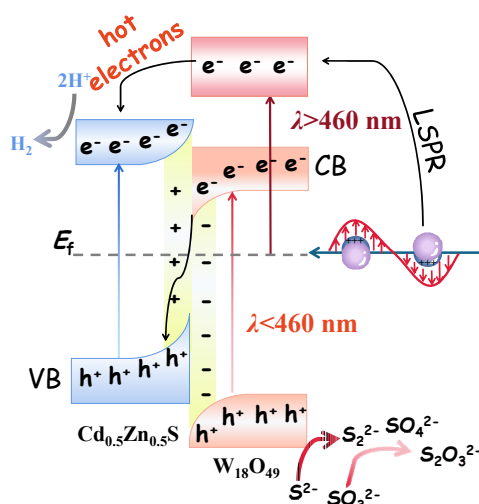
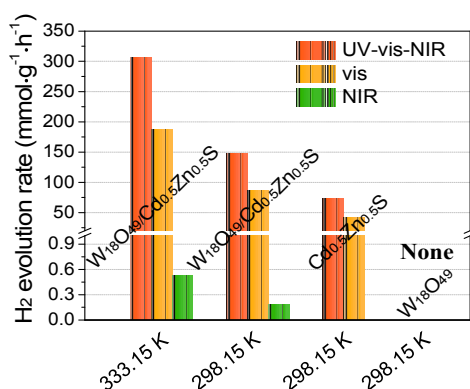
Upon light irradiation, ZnO nanorods possess the superior photocatalytic activity for hydrogen peroxide production by means of two-step single-electron oxygen reduction.



Chin. J. Catal., 2022, 43: 234–245 doi: 10.1016/S1872-2067(20)63783-4

UV-VIS-NIR-induced extraordinary H₂ evolution over W₁₈O₄₉/Cd_{0.5}Zn_{0.5}S: Surface plasmon effect coupled with S-scheme charge transfer

Wenhua Xue, Hongli Sun, Xiaoyun Hu, Xue Bai, Jun Fan, Enzhou Liu*
Northwest University



An ultraviolet-visible-near infrared induced extraordinary H₂ evolution over W₁₈O₄₉/Cd_{0.5}Zn_{0.5}S photocatalyst based on the surface plasma effect and the S-scheme charge transfer.

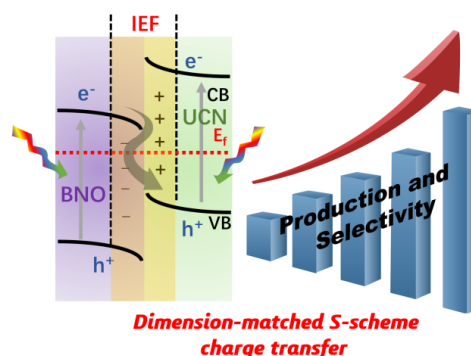
Chin. J. Catal., 2022, 43: 246–254 doi: 10.1016/S1872-2067(21)63819-6

Selective CO₂ photoreduction to CH₄ mediated by dimension-matched 2D/2D Bi₃NbO₇/g-C₃N₄ S-scheme heterojunction

Kai Wang*, Xuezheng Feng, Yangzi Shangguan, Xiaoyong Wu*, Hong Chen*

Hubei Normal University; Wuhan University of Technology; Southern University of Science and Technology

Dimension-matched S-scheme Bi₃NbO₇/g-C₃N₄ heterojunctions were synthesized by a facile solvothermal approach and were capable of achieving selective CO₂ reduction to CH₄. The presence of the internal electric field in the Bi₃NbO₇/g-C₃N₄ heterojunction efficiently separates photoinduced charge carriers through an S-scheme mechanism.



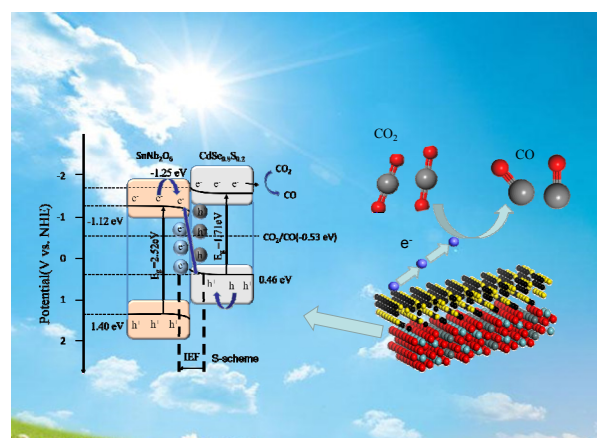
Chin. J. Catal., 2022, 43: 255–264 doi: 10.1016/S1872-2067(20)63784-6

Organic amine surface modified one-dimensional CdSe_{0.8}S_{0.2}-diethylenetriamine/two-dimensional SnNb₂O₆ S-scheme heterojunction with promoted visible-light-driven photocatalytic CO₂ reduction

Hui Yang, Jin feng Zhang*, Kai Dai*

HuaiBei Normal University

An S-scheme CdSe_{0.8}S_{0.2}-DETA/SnNb₂O₆ heterojunction was successfully fabricated by hydrothermal and chemical deposition processes. The heterojunction is favorable for photocatalytic CO₂ reduction, which is attributed to the spatial separation of electron-hole pairs and improved transmission efficiency.



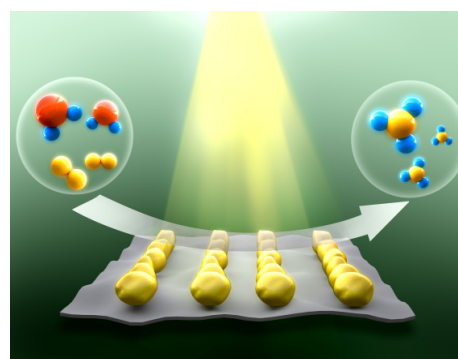
Chin. J. Catal., 2022, 43: 265–275 doi: 10.1016/S1872-2067(21)63801-9

Boosting the catalytic activity of a step-scheme In₂O₃/ZnIn₂S₄ hybrid system for the photofixation of nitrogen

Jin Zhang, Zi-Hao Pan, Ying Yang, Peng-Fei Wang, Chen-Yang Pei, Wei Chen*, Guo-Bo Huang*

Taizhou University

An In₂O₃/ZnIn₂S₄ hybrid system shows enhanced photocatalytic activity for the fixation of nitrogen as a result of the synergistic effect of oxygen vacancies and a step-scheme charge-separation mechanism.



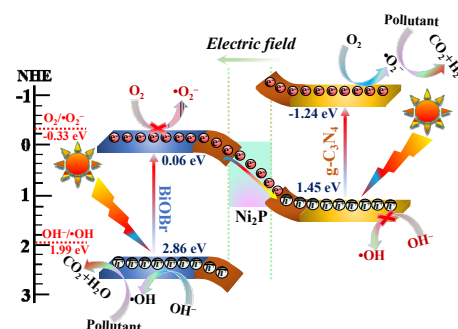
Chin. J. Catal., 2022, 43: 276–287 doi: 10.1016/S1872-2067(21)63817-2

Promoting photocarriers separation in S-scheme system with Ni₂P electron bridge: The case study of BiOBr/Ni₂P/g-C₃N₄

Nannan Chen, Xuemei Jia, Heng He, Haili Lin*, Minna Guo, Jing Cao, Jinfeng Zhang, Shifu Chen*

HuaiBei Normal University

A dual adjustment for Ni₂P electron bridge and S-scheme heterojunction was realized on a BiOBr/Ni₂P/g-C₃N₄ composite prepared via a deposition-precipitation method, which exhibited largely enhanced visible light photocatalytic activity.

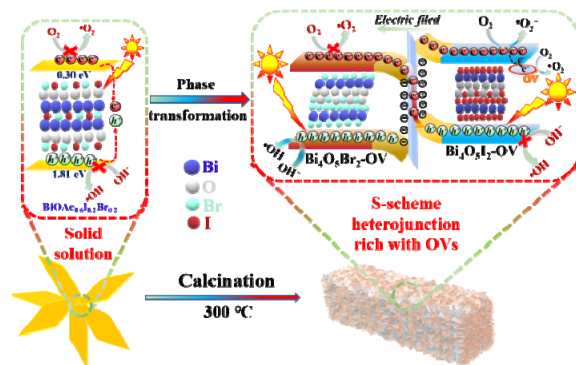


Chin. J. Catal., 2022, 43: 288–302 doi: 10.1016/S1872-2067(20)63768-8

Rod-like $\text{Bi}_4\text{O}_5\text{I}_2/\text{Bi}_4\text{O}_5\text{Br}_2$ step-scheme heterostructure with oxygen vacancies synthesized by calcining the solid solution containing organic group

Xuemei Jia, Zichen Shen, Qiaofeng Han *, Huiping Bi
Nanjing University of Science and Technology

A dual adjustment for surface OV and S-scheme heterojunction was realized on 1D nanorod-like $\text{Bi}_4\text{O}_5\text{I}_2/\text{Bi}_4\text{O}_5\text{Br}_2$ heterojunction prepared via low temperature calcination of 2D nanosheets $\text{BiOAc}_{0.6}\text{Br}_{0.2}\text{I}_{0.2}$ solid solution, which exhibited largely enhanced visible photocatalytic activity.

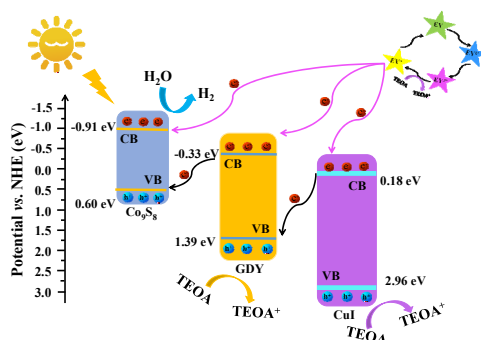


Chin. J. Catal., 2022, 43: 303–315 doi: 10.1016/S1872-2067(21)63818-4

Efficient photocatalytic hydrogen evolution over graphdiyne boosted with a cobalt sulfide formed S-scheme heterojunction

Zhiliang Jin *, Hongying Li *, Junke Li
North Minzu University

The special structure of GDY-CuI and the existence of the S-scheme heterojunction between Co_9S_8 provide a special transmission path for the transfer of electrons between semiconductors so that it has good hydrogen production performance.

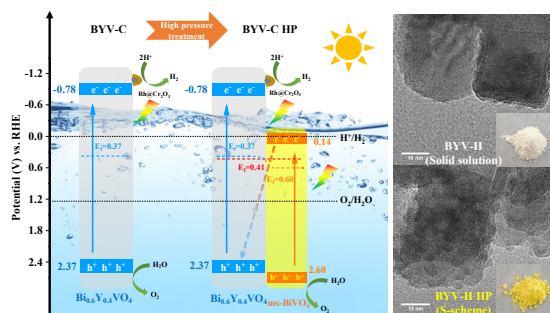


Chin. J. Catal., 2022, 43: 316–328 doi: 10.1016/S1872-2067(21)63846-9

In-situ pressure-induced $\text{BiVO}_4/\text{Bi}_{0.6}\text{Y}_{0.4}\text{VO}_4$ S-scheme heterojunction for enhanced photocatalytic overall water splitting activity

Weiqi Guo, Haolin Luo, Zhi Jiang *, Wenfeng Shangguan
Shanghai Jiao Tong University

The enhanced photocatalytic OWS performance was achieved in BYV-H HP, which was based on the effective charge separation route of the S-scheme heterojunction constructed by the pressure-induced phase transition of BiVO_4 .

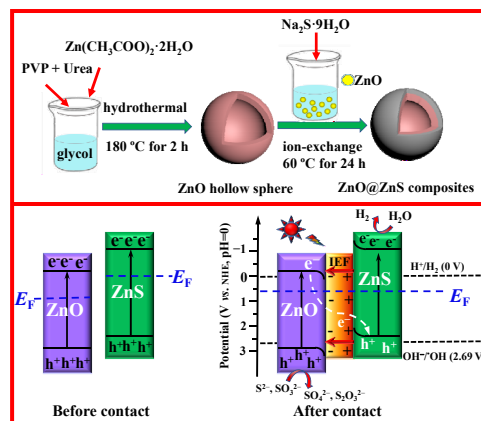


Chin. J. Catal., 2022, 43: 329–338 doi: 10.1016/S1872-2067(21)63889-5

Step-scheme $\text{ZnO}@/\text{ZnS}$ hollow microspheres for improved photocatalytic H_2 production performance

Jie Jiang, Guohong Wang *, Yanchi Shao, Juan Wang, Shuang Zhou *, Yaorong Su
Hubei Normal University; Shenzhen Technology University

The hierarchical $\text{ZnO}@/\text{ZnS}$ step-scheme photocatalyst with a hollow microsphere structure delivers superior hydrogen evolution performance compared to pure ZnO and ZnS due to formation of a S-scheme heterojunction between ZnO and ZnS.



Chin. J. Catal., 2022, 43: 339–349 doi: 10.1016/S1872-2067(21)63875-5

1D/2D TiO₂/ZnIn₂S₄ S-scheme heterojunction photocatalyst for efficient hydrogen evolution

Jinmao Li, Congcong Wu, Jin Li *, Binghai Dong, Li Zhao *, Shimin Wang *
Hubei University; Hubei Normal University

The TiO₂/ZnIn₂S₄ composite prepared by the *in-situ* growth of ZnIn₂S₄ on TiO₂ nanofibers exhibits remarkable photocatalytic hydrogen evolution activity. The S-scheme charge transfer route enhances the separation efficiency of the photoexcited carriers as well as the photocatalytic activity.

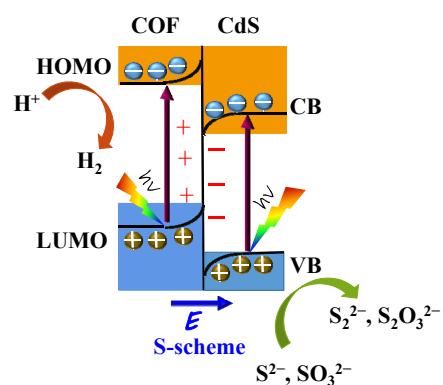


Chin. J. Catal., 2022, 43: 350–358 doi: 10.1016/S1872-2067(21)63869-X

Fabricating covalent organic framework/CdS S-scheme heterojunctions for improved solar hydrogen generation

Long Sun, Lingling Li, Juan Yang, Jiajie Fan *, Quanlong Xu *
Wenzhou University; Zhengzhou University;
Guangdong University of Technology

CdS hollow cube structures are combined with an imine-based porous COF to fabricate an S-scheme heterojunction, which maintains a strong redox ability and improves the photocatalytic H₂ generation efficiency.

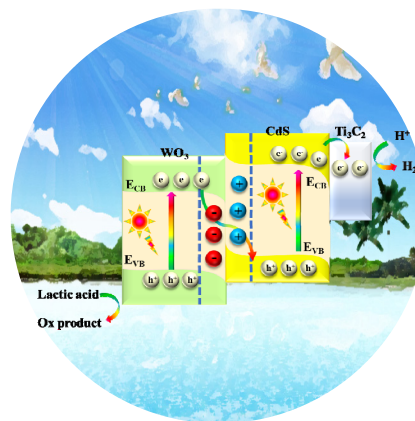


Chin. J. Catal., 2022, 43: 359–369 doi: 10.1016/S1872-2067(21)63883-4

Integration of 2D layered CdS/WO₃ S-scheme heterojunctions and metallic Ti₃C₂ MXene-based Ohmic junctions for effective photocatalytic H₂ generation

Junxian Bai, Rongchen Shen, Kang Zhou, Zhimin Jiang, Peng Zhang, Xin Li *
South China Agricultural University; Zhengzhou University

Constructing an S-scheme heterojunction reduces the recombination of photogenerated electron-hole pairs and maintains electrons with strong reducibility. The loading of MX offers more hydrogen active sites and effectively utilizes electrons for photocatalytic reactions through ohmic junctions.

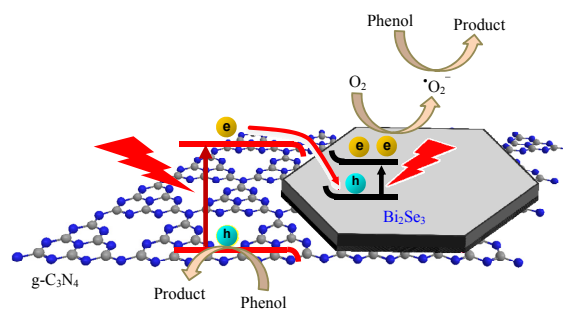


Chin. J. Catal., 2022, 43: 370–378 doi: 10.1016/S1872-2067(21)63911-6

In situ fabrication of Bi₂Se₃/g-C₃N₄ S-scheme photocatalyst with improved photocatalytic activity

Rongan He, Sijiao Ou, Yexuan Liu, Yu Liu, Difa Xu *
Changsha University

Under visible light irradiation, the Bi₂Se₃/g-C₃N₄ composite exhibited superior photocatalytic activity for the degradation of phenol through an S-scheme mechanism.

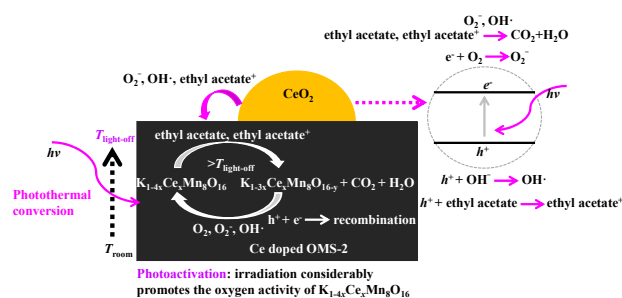


Chin. J. Catal., 2022, 43: 379–390 doi: 10.1016/S1872-2067(21)63816-0

Highly efficient UV-visible-infrared photothermocatalytic removal of ethyl acetate over a nanocomposite of CeO₂ and Ce-doped manganese oxide

Long Zhang, Yi Yang, Yuanzhi Li*, Jichun Wu, Shaowen Wu, Xin Tan, Qianqian Hu
Wuhan University of Technology; Huazhong Agricultural University

A CeO₂-CeOMS-2 nanocomposite exhibited extremely high photothermocatalytic activity and excellent durability for ethyl acetate removal under UV-vis-IR irradiation. The high activity is a result of synergetic photocatalysis, light-driven thermocatalysis, and novel photoactivation.

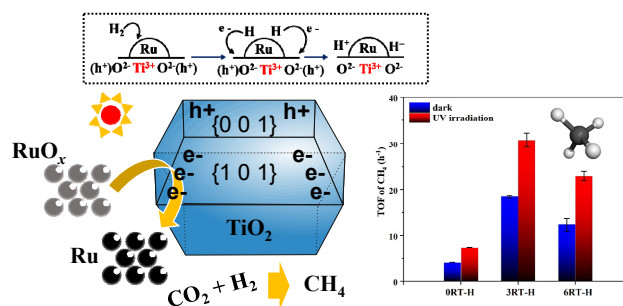


Chin. J. Catal., 2022, 43: 391–402 doi: 10.1016/S1872-2067(21)63825-1

Photo-enhanced thermal catalytic CO₂ methanation activity and stability over oxygen-deficient Ru/TiO₂ with exposed TiO₂ {001} facets: Adjusting photogenerated electron behaviors by metal-support interactions

Ke Wang, Shihui He, Yunzhi Lin, Xun Chen, Wenxin Dai*, Xianzhi Fu*
Fuzhou University

The photogenerated electrons was affected by the various support-metal interaction, so the regenerated surface oxygen vacancies could further promote the CO₂ methanation under UV irradiation on the Ru/TiO₂ exposed TiO {001} facet.

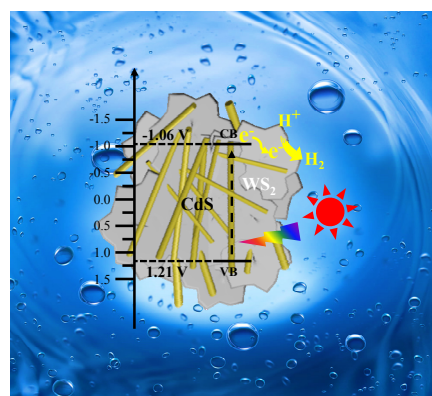


Chin. J. Catal., 2022, 43: 403–409 doi: 10.1016/S1872-2067(21)63844-5

Ultrahigh photocatalytic hydrogen evolution performance of coupled 1D CdS/1T-phase dominated 2D WS₂ nanoheterojunctions

Chao Ding, Chengxiao Zhao, Shi Cheng, Xiaofei Yang*
Nanjing Forestry University

1T-phase dominated WS₂ nanosheets with high conductivity and large specific surface area were employed to construct mixed-dimensional heterojunctions for ultrahigh solar-powered photocatalytic hydrogen evolution *via* water splitting.

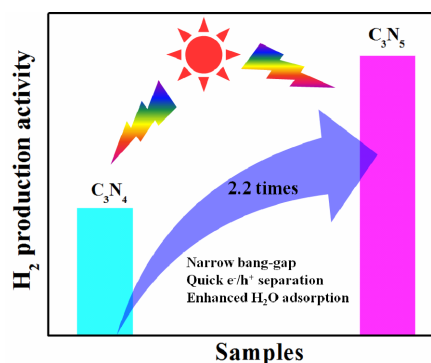


Chin. J. Catal., 2022, 43: 410–420 doi: 10.1016/S1872-2067(21)63813-5

Comprehensive investigation on robust photocatalytic hydrogen production over C₃N₅

Cong Peng, Lixiao Han, Jinming Huang, Shengyao Wang, Xiaohu Zhang*, Hao Chen*
Huazhong Agricultural University

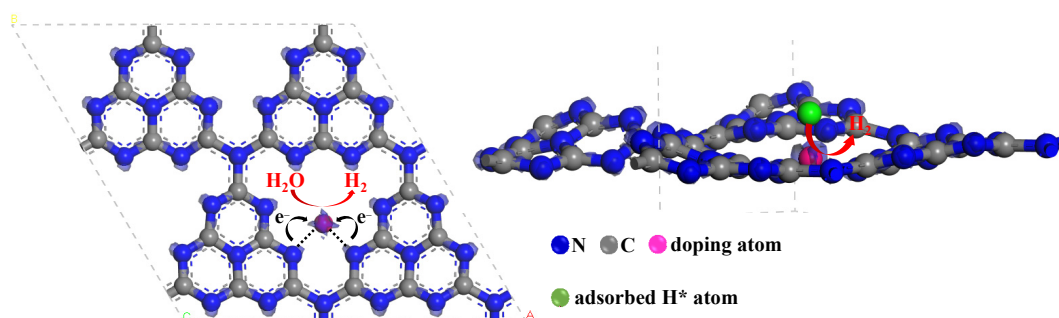
As a new type of carbon nitride, C₃N₅ exhibits much higher photocatalytic H₂ production activity than conventional C₃N₄, which represents a new direction for designing materials for photocatalytic applications.



Chin. J. Catal., 2022, 43: 421–432 doi: 10.1016/S1872-2067(21)63849-4

Doping-induced metal-N active sites and bandgap engineering in graphitic carbon nitride for enhancing photocatalytic H₂ evolution performance

Xiaohui Yu, Haiwei Su, Jianping Zou *, Qinqin Liu *, Lele Wang, Hua Tang *
Jiangsu University; Nanchang Hangkong University; Qingdao University



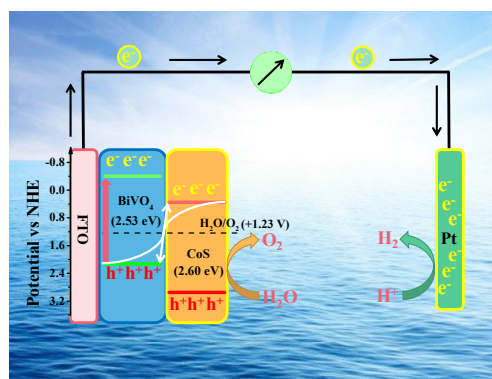
Atomic-level structural engineering of g-C₃N₄ induced metal-N active sites in the framework and modulated the bandgap structure, thereby improving the separation efficiency of photogenerated charges, reductive ability, and light absorption.

Chin. J. Catal., 2022, 43: 433–441 doi: 10.1016/S1872-2067(21)63845-7

Enhanced photoelectrochemical water splitting using a cobalt-sulfide-decorated BiVO₄ photoanode

Zhiming Zhou, Jinjin Chen, Qinlong Wang, Xingxing Jiang, Yan Shen *
Huazhong University of Science and Technology

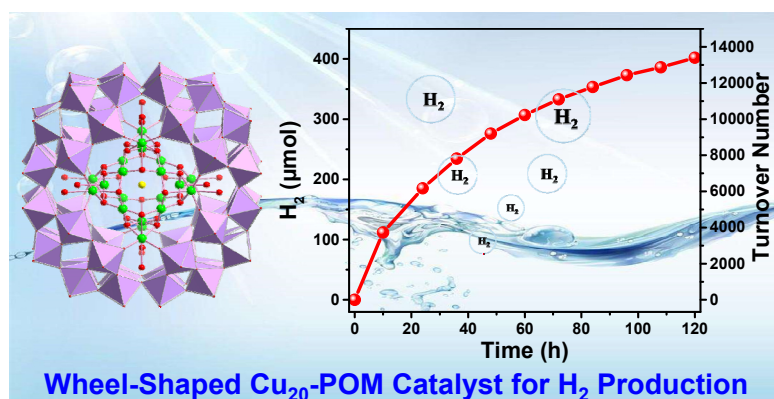
An excellent CoS/BiVO₄ photoanode was prepared by decorating CoS onto the surface of BiVO₄. The resulting CoS/BiVO₄ photoanode exhibited a significantly enhanced photocurrent density with considerably enhanced charge injection and separation efficiencies compared to those of pure BiVO₄. This study provides valuable instructions for surface-modification-based design and decoration of photoanodes for efficient photoelectrochemical water splitting.



Chin. J. Catal., 2022, 43: 442–450 doi: 10.1016/S1872-2067(21)63840-8

Wheel-shaped icosanuclear Cu-containing polyoxometalate catalyst: Mechanistic and stability studies on light-driven hydrogen generation

Yeqin Feng, Lin Qin, Junhao Zhang, Fangyu Fu *, Huijie Li, Hua Xiang, Hongjin Lv *
Beijing Institute of Technology

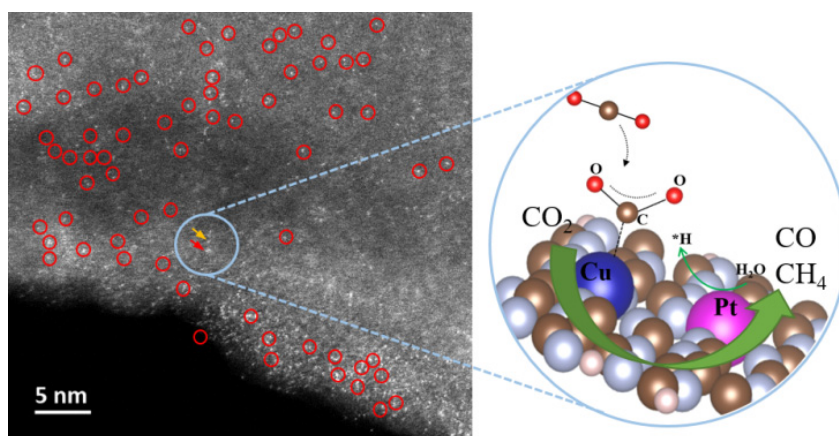


A wheel-shaped icosanuclear Cu-containing polyoxometalate (**Cu₂₀-POM**) was synthesized and investigated as an efficient catalyst for visible-light-driven H₂ production. It achieved an exceptionally high turnover number of ~13400 after 120 h of photocatalytic reaction. The catalytic mechanism and catalyst stability under turnover conditions were systematically studied using various spectroscopic and experimental techniques.

Chin. J. Catal., 2022, 43: 451–460 doi: 10.1016/S1872-2067(21)63879-2

Copper and platinum dual-single-atoms supported on crystalline graphitic carbon nitride for enhanced photocatalytic CO₂ reduction

Lei Cheng, Peng Zhang, Qiye Wen, Jiajie Fan, Quanjun Xiang*
University of Electronic Science and Technology of China; Zhengzhou University



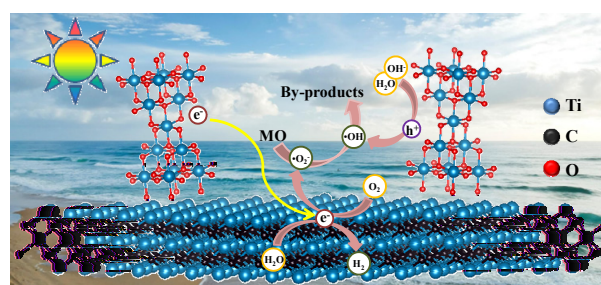
Atomically dispersed Pt-Cu sites inside crystalline carbon nitride were designed to maximize Pt mass activity and integrate their respective merits, leading to enhanced CO₂ photoreduction.

Chin. J. Catal., 2022, 43: 461–471 doi: 10.1016/S1872-2067(21)63915-3

Ti₃C₂ MXene co-catalyst assembled with mesoporous TiO₂ for boosting photocatalytic activity of methyl orange degradation and hydrogen production

Huapeng Li, Bin Sun*, Tingting Gao, Huan Li, Yongqiang Ren,
 Guowei Zhou*
Qilu University of Technology (Shandong Academy of Sciences)

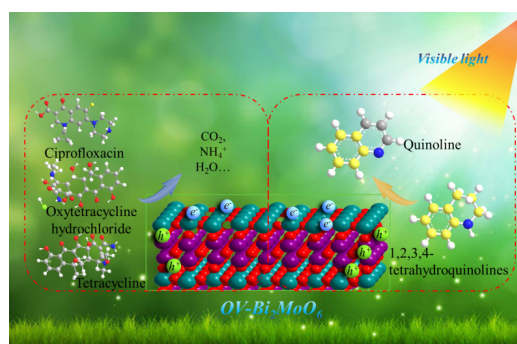
Mesoporous TiO₂/Ti₃C₂ composites are fabricated by electrostatic self-assembly strategy, exhibiting a considerable improvement in the photocatalytic methyl orange degradation and H₂ production through introducing the highly conductive Ti₃C₂ MXene as co-catalyst.



Chin. J. Catal., 2022, 43: 472–484 doi: 10.1016/S1872-2067(21)63876-7

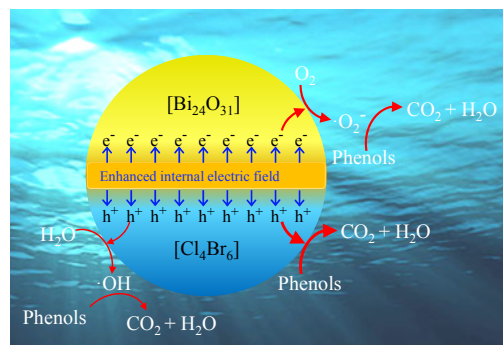
Solvothermal fabrication of Bi₂MoO₆ nanocrystals with tunable oxygen vacancies and excellent photocatalytic oxidation performance in quinoline production and antibiotics degradation

Zhen Liu, Jian Tian, Changlin Yu*, Qizhe Fan, Xingqiang Liu*
Guangdong University of Petrochemical Technology; Harbin Institute of Technology (Shenzhen); Xiamen University Tan Kah Kee College



Excellent photocatalytic performance in the oxidation of 1,2,3,4-tetrahydroquinoline to produce quinoline and in antibiotic degradation was obtained over novel Bi₂MoO₆ nanocrystals with tunable oxygen vacancies under visible light irradiation.

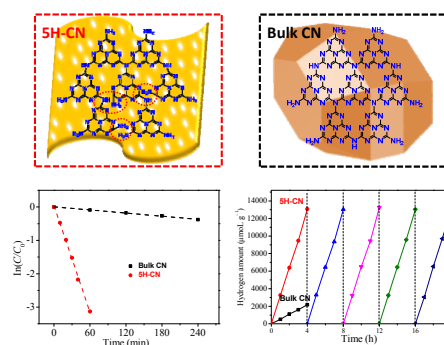
Chin. J. Catal., 2022, 43: 485–496 doi: 10.1016/S1872-2067(21)63897-4

Enhancing an internal electric field by a solid solution strategy for steering bulk-charge flow and boosting photocatalytic activity of $\text{Bi}_{24}\text{O}_{31}\text{Cl}_x\text{Br}_{10-x}$ Jun Wan, Weijie Yang, Jiaqing Liu, Kailong Sun, Lin Liu *, Feng Fu *
Yan'an University;
Clean Utilization of Low Rank Coal of Shaanxi Collaborative Innovation CenterThe unsymmetrical crystal structure construction of a $\text{Bi}_{24}\text{O}_{31}\text{Cl}_4\text{Br}_6$ solid solution strategy could remarkably enhance the internal electric field, resulting in bulk-charge flow in a desired and efficient manner to dramatically improve the photocatalytic degradation of phenolic compounds.

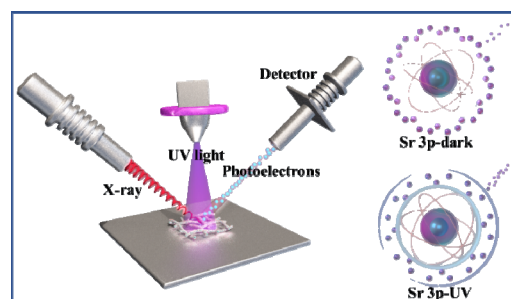
Chin. J. Catal., 2022, 43: 497–506 doi: 10.1016/S1872-2067(21)63873-1

Precursor-modified strategy to synthesize thin porous amino-rich graphitic carbon nitride with enhanced photocatalytic degradation of RhB and hydrogen evolution performancesTing Huang, Jiaqi Chen, Lili Zhang, Alireza Khataee, Qiaofeng Han, Xiaoheng Liu, Jingwen Sun, Junwu Zhu, Shugang Pan *, Xin Wang *, Yongsheng Fu *
Nanjing University of Science and Technology, China;
Huaiyin Normal University, China; University of Tabriz, Iran;
Changzhou Institute of Technology, China

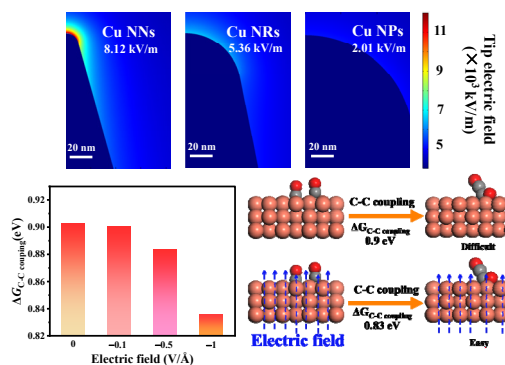
The self-modified thin porous amino-rich 5H-CN was successfully synthesized via a precursor-modified strategy, and it displays outstanding photocatalytic performance in the degradation of RhB and hydrogen evolution, which is much higher than that of bulk CN.



Chin. J. Catal., 2022, 43: 507–518 doi: 10.1016/S1872-2067(21)63898-6

Tracking charge transfer pathways in $\text{SrTiO}_3/\text{CoP}/\text{Mo}_2\text{C}$ nanofibers for enhanced photocatalytic solar fuel productionLi Wang, Yukun Li, Chao Wu, Xin Li, Guosheng Shao *, Peng Zhang *
Zhengzhou University; South China Agricultural UniversityA dual cocatalysts system for photocatalytic solar fuel production was constructed, and we confirmed the band bending and photoexcited electron transfer pathway between the SrTiO_3 and cocatalysts using UPS and ISI-XPS characterization.

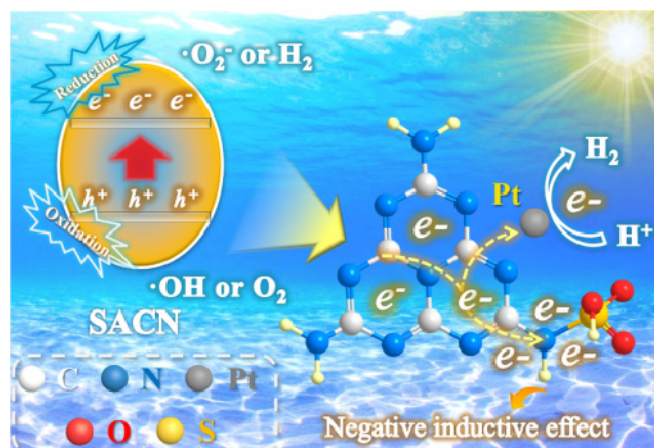
Chin. J. Catal., 2022, 43: 519–525 doi: 10.1016/S1872-2067(21)63866-4

Electric-field promoted C–C coupling over Cu nanoneedles for CO_2 electroreduction to C_2 productsHuangJingWei Li, Huimin Zhou, Yajiao Zhou, Junhua Hu, Masahiro Miyauchi, Junwei Fu *, Min Liu *
Central South University, China; Zhengzhou University, China;
Tokyo Institute of Technology, JapanFinite-element simulations and DFT calculations were used to predict that highly curved copper nanoneedles exhibit a strong electric field, which can promote C–C coupling and thus improve the generation of multi-carbon (C_2) products during the electroreduction of CO_2 .

Chin. J. Catal., 2022, 43: 526–535 doi: 10.1016/S1872-2067(21)63872-X

Negative inductive effect enhances charge transfer driving in sulfonic acid functionalized graphitic carbon nitride with efficient visible-light photocatalytic performance

Min Zhang, Yunfeng Li *, Wei Chang, Wei Zhu *, Luohong Zhang, Renxi Jin, Yan Xing
Xi'an Polytechnic University, China; University of Notre Dame, USA; Northeast Normal University, China

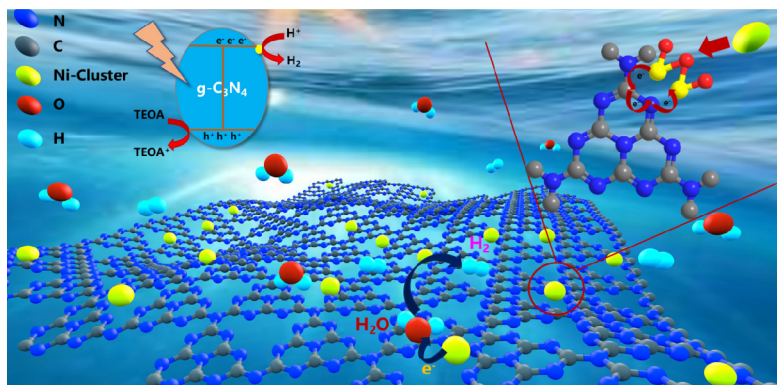


Sulfonic acid group-functionalized g-C₃N₄ has been synthesized successfully. The driving force generated by the negative inductive effect of sulfonic acid groups significantly improves the charge transfer dynamics and inhibits their recombination, thus leading to excellent photocatalytic performance.

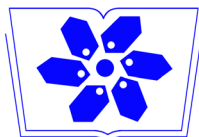
Chin. J. Catal., 2022, 43: 536–545 doi: 10.1016/S1872-2067(21)63865-2

Monodisperse Ni-clusters anchored on carbon nitride for efficient photocatalytic hydrogen evolution

Liang Jian, Huizhen Zhang, Bing Liu, Chengsi Pan, Yuming Dong *, Guangli Wang, Jun Zhong, Yongjie Zheng, Yongfa Zhu *
Jiangnan University; Soochow University; Qingdao Geological Exploration Institute of China Metallurgical Geology Bureau; Tsinghua University



Monodisperse Ni-clusters were anchored on the CN surface for efficient photocatalytic hydrogen evolution. It has been proven that there is a stable interface interaction between monodisperse Ni-clusters and CN to construct the hybrid electronic structure of the Ni-cluster/CN system.



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第三届华人光催化材料学术研讨会专刊

客座主编: 余家国, 余长林, 余火根

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