

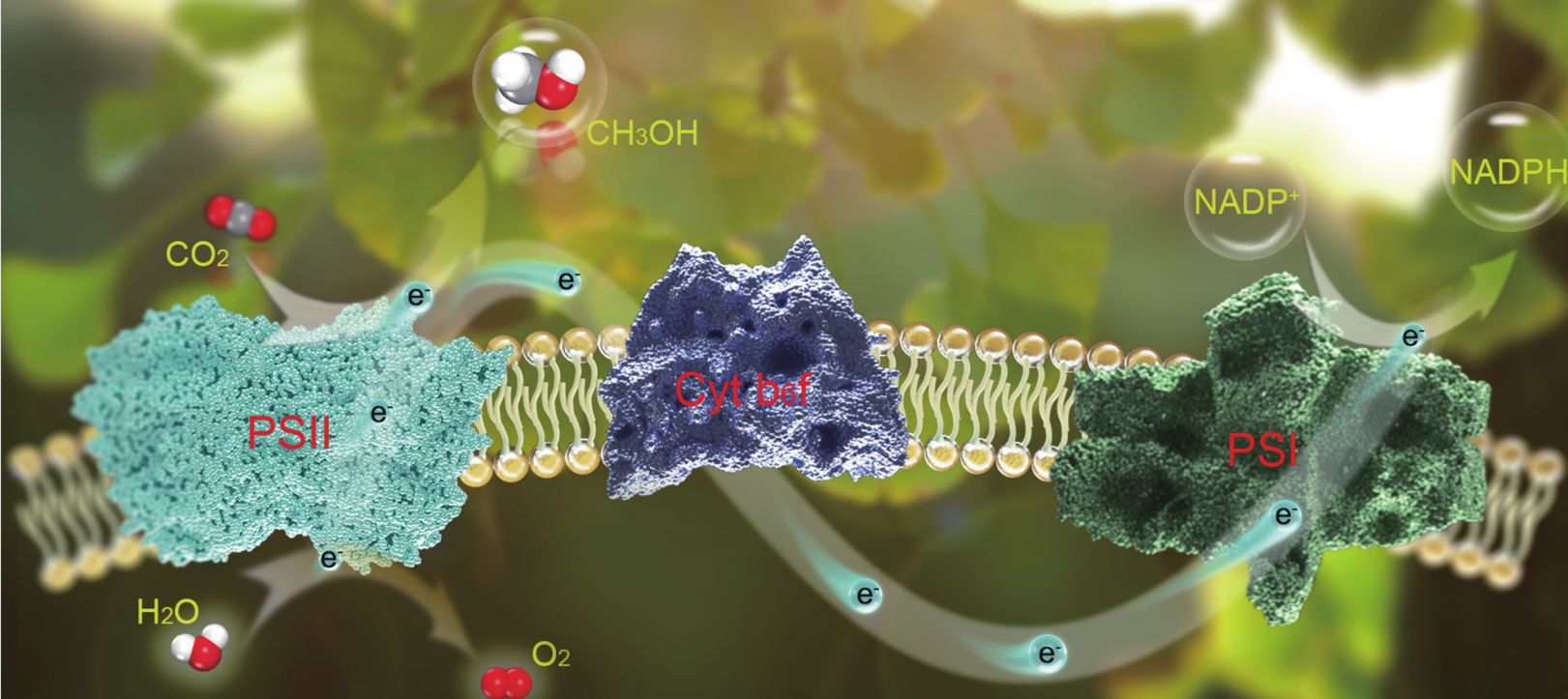
ISSN 0253-9837
CN 21-1601/O6



Chinese Journal of Catalysis

Editors-in-Chief Can Li Tao Zhang

Volume 44 | January | 2023



www.cjcatal.com

Transaction of The Catalysis Society of China

万方数据

CHINESE JOURNAL OF CATALYSIS

January 2023

Vol. 44

Pages 1-178

目次

亮点

1

单原子催化剂大数据库

韩璟怡, 管景奇

4

太阳能驱动 H_2O_2 的原位生产与利用: 自循环光催化芬顿系统

张鹏, 李佑稷, 李鑫

综述

7

过渡金属硫化物相关电催化剂的设计与应用研究

苏慧, 姜静, 宋少佳, 安博涵, 李宁, 高旸钦, 戈磊

50

氮还原反应中氮定量假阳性结果的来源与消除方法

李雅, 王震康, 李浩卿, 张莉芳, 钱涛, 晏成林, 路建美

67

铜基三元金属硫化物催化剂在光催化二氧化碳还原领域中的研究进展

杨金曼, 杨铮睿, 杨科芬, 于卿, 朱兴旺, 许晖, 李华明

96

酶-光偶联催化系统中分子-电子-质子传递过程与机制

李诗浩, 石家福, 刘书松, 李文萍, 陈裕, 单慧婷, 程雨晴, 吴洪, 姜忠义

快讯

111

可见光诱导Z型 $\text{V}_2\text{O}_5/\text{g-C}_3\text{N}_4$ 异质结催化未活化烯烃串联反应

桂清文, 滕帆, 喻鹏, 吴一帆, 农志彬, 杨龙汐, 陈祥, 阳天宝, 何卫民

论文

117

光系统II光驱动 CO_2 同化的光合作用

李跃辉, 司端惠, 王旺银, 薛松, 商文喆, 迟占有, 李灿, 郝策, Govindjee Govindjee, 史彦涛

127

镍铁层状双金属氢氧化物在不同pH电解液体系中的析氧反应

谢起贤, 任丹, 柏力晨, 格日乐, 周雯慧, 白璐, 谢微, 王军虎, Michael Grätzel, 罗景山

139

酶-金属单原子复合催化剂在一锅法生物-化学反应的应用

黎晓阳, 曹宇飞, 熊佳容, 李隽, 肖海, 李昕阳, 苟清强, 戈钧

146

2D/2D超薄 $\text{La}_2\text{Ti}_2\text{O}_7/\text{Ti}_3\text{C}_2$ Mxene肖特基异质结用于高效光催化 CO_2 还原

王可, 程淼, 王楠, 张千一, 刘懿, 梁俊威, 管杰, 刘茂昌, 周建成, 李乃旭

160

绿藻来源光脱羧酶McFAP的挖掘及其中短链脂肪酸选择性脱羧机制研究

马云建, 仲宣儒, 吴斌, 蓝东明, 张皓, 弗兰克·霍尔曼, 王永华

171

苯乙烯及其衍生物的生物氨基化反应用于 β -氨基醇的高效合成

胡瑞文, 龚安界, 廖浪星, 郑颜欣, 刘鑫, 吴鹏, 李福帅, 郁慧丽, 赵晶, 叶龙武, 王斌举, 李爱涛

广告信息

北京世纪森朗实验仪器有限公司 正文后1

北京七星华创流量计有限公司 封三

莱北仪器 封底

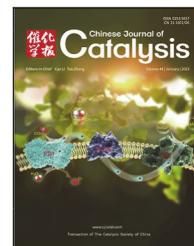
英文全文电子版(国际版)由Elsevier出版社在ScienceDirect上出版

<https://www.sciencedirect.com/journal/chinese-journal-of-catalysis>

www.cjcatal.com

在线投稿网址

<https://mc03.manuscriptcentral.com/cjcatal>

available at www.sciencedirect.comjournal homepage: www.sciencedirect.com/journal/chinese-journal-of-catalysis

Chinese Journal of Catalysis

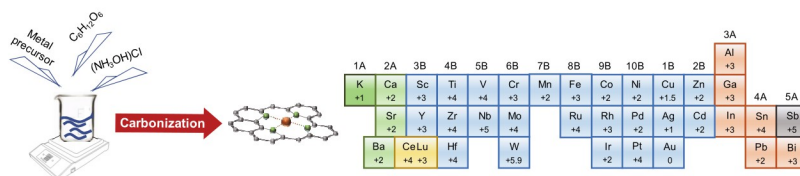
Graphical Contents

Highlights

Chin. J. Catal., 2023, 44: 1–3 doi: 10.1016/S1872-2067(22)64153-6

A macro library for monatomic catalysts

Jingyi Han, Jingqi Guan *
Jilin University



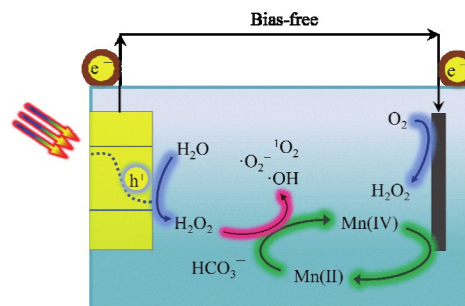
Atomically dispersed catalysts have become a research frontier due to their excellent catalytic activity and selectivity, but the controllable synthesis is still challenging. A library containing 37 elements was created to guide the fabrication of monoatomic catalysts.

Chin. J. Catal., 2023, 44: 4–6 doi: 10.1016/S1872-2067(22)64185-8

Solar to H₂O₂ *in-situ* generation and utilization: A self-cyclable photocatalytic Fenton-like system

Peng Zhang *, Youji Li, Xin Li *
Zhengzhou University;
Jishou University;
South China Agricultural University

The necessity and challenges associated with the new-type photocatalytic Fenton-like system was introduced, followed by the discussion of the innovation and breakthrough of the self-cyclable photo-Fenton system in this highlights. An inspiration towards new-generation decentralized sustainable environment treatment device is expected.



Reviews

Chin. J. Catal., 2023, 44: 7–49 doi: 10.1016/S1872-2067(22)64149-4

Recent progress on design and applications of transition metal chalcogenide-associated electrocatalysts for the overall water splitting

Hui Su, Jing Jiang, Shaojia Song, Bohan An, Ning Li, Yangqin Gao, Lei Ge *
China University of Petroleum Beijing

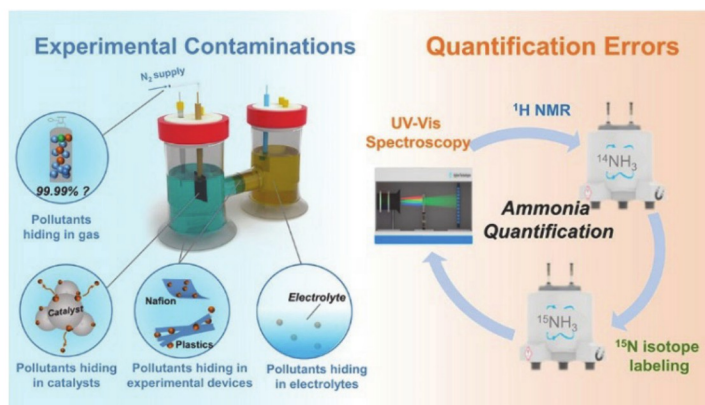
The synthesis method and design principle of transition metal sulfide electrocatalytic materials are introduced, and the catalytic mechanism of OER and HER in electrocatalytic water is analyzed, which provides reference for rational design and research of efficient electrocatalysts.



Chin. J. Catal., 2023, 44: 50–66 doi: 10.1016/S1872-2067(22)64148-2

Excluding false positives: A perspective toward credible ammonia quantification in nitrogen reduction reaction

Ya Li, Zhenkang Wang, Haoqing Ji, Lifang Zhang, Tao Qian, Chenglin Yan *, Jianmei Lu *
Soochow University; Nantong University

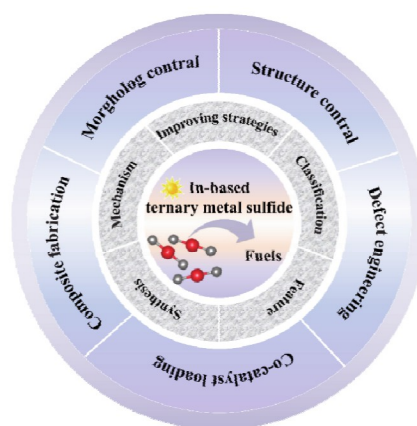


The potential factors affect credible ammonia quantification in nitrogen reduction reaction (NRR) towards ammonia, including the aspects of catalyst materials, experimental process, and quantification methods, and how they disturb the final results of ammonia quantification.

Chin. J. Catal., 2023, 44: 67–95 doi: 10.1016/S1872-2067(22)64152-4

Indium-based ternary metal sulfide for photocatalytic CO₂ reduction application

Jinman Yang, Zhengrui Yang, Kefen Yang, Qing Yu, Xingwang Zhu, Hui Xu *, Huaming Li *
Jiangsu University;
Yangzhou University

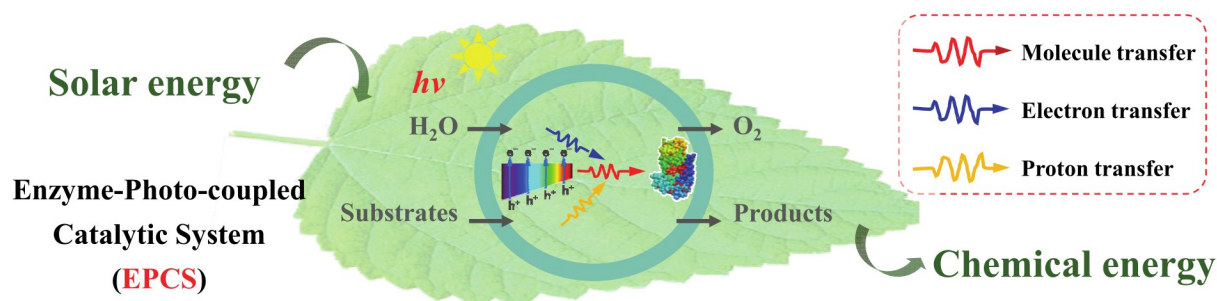


Recent advances of In-based ternary metal sulfide in the field of photocatalytic CO₂ reduction have been systematically summarized and critically reviewed, highlighting the modification strategies and improving mechanisms of In-based ternary metal sulfide for achieving high performance.

Chin. J. Catal., 2023, 44: 96–110 doi: 10.1016/S1872-2067(22)64154-8

Molecule-electron-proton transfer in enzyme-photo-coupled catalytic system

Shihao Li, Jiafu Shi *, Shusong Liu, Wenping Li, Yu Chen, Huiting Shan, Yuqing Cheng, Hong Wu *, Zhongyi Jiang *
Tianjin University; Collaborative Innovation Center of Chemical Science and Engineering (Tianjin);
Joint School of National University of Singapore and Tianjin University



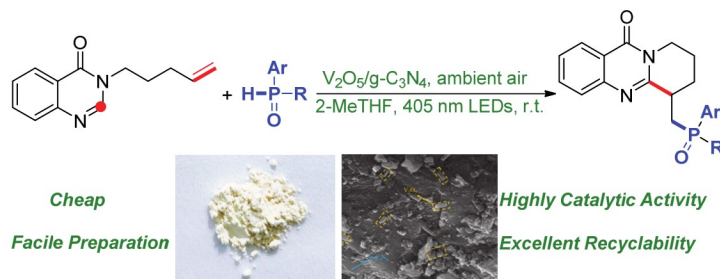
Enzyme-Photo-coupled Catalytic System (EPCS) is an emerging solar-driven biomanufacturing technique. The essence of mass/energy exchange in EPCS can be depicted as molecule, electron and proton transfer. The synergistic intensification of molecule-electron-proton transfer is important in fortifying the mass/energy exchange in EPCS.

Communication

Chin. J. Catal., 2023, 44: 111–116 doi: 10.1016/S1872-2067(22)64162-7

Visible light-induced Z-scheme $\text{V}_2\text{O}_5/\text{g-C}_3\text{N}_4$ heterojunction catalyzed cascade reaction of unactivated alkenes

Qing-Wen Gui, Fan Teng, Peng Yu, Yi-Fan Wu, Zhi-Bin Nong, Long-Xi Yang, Xiang Chen, Tian-Bao Yang, Wei-Min He *
Hunan Agricultural University; University of South China



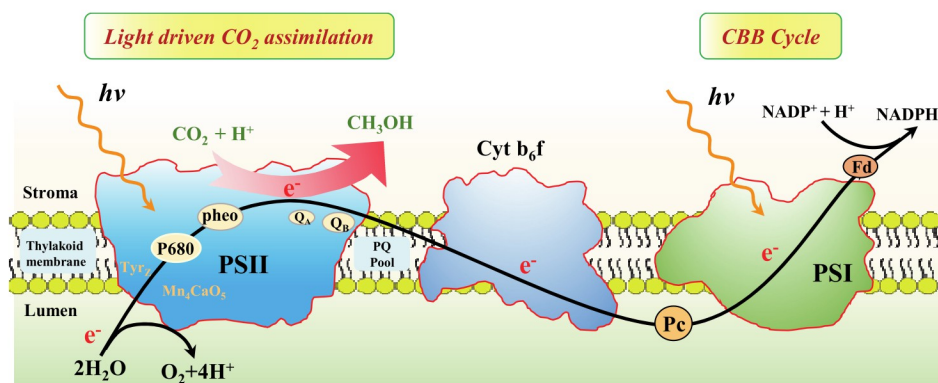
The Z-scheme $\text{V}_2\text{O}_5/\text{g-C}_3\text{N}_4$ heterojunction was applied in heterogeneous photocatalytic cascade reaction for constructing phosphorylated ring-fused quinazolinones. Both the photogenerated hole and photogenerated electron played a vital role in the cascade process.

Articles

Chin. J. Catal., 2023, 44: 117–126 doi: 10.1016/S1872-2067(22)64170-6

Light-driven CO_2 assimilation by photosystem II and its relation to photosynthesis

Yuehui Li, Duanhui Si, Wangyin Wang *, Song Xue, Wenzhe Shang, Zhanyou Chi, Can Li, Ce Hao *, Govindjee Govindjee, Yantao Shi *
Dalian University of Technology, China; Dalian Institute of Chemical Physics, Chinese Academy of Sciences, China;
University of Illinois at Urbana-Champaign, USA

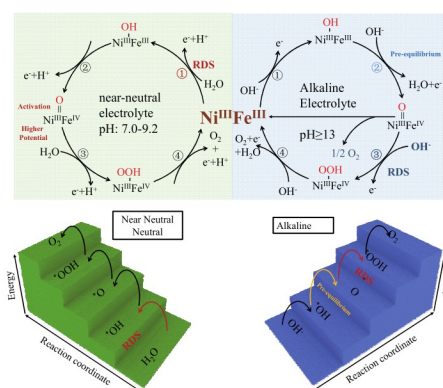


An unusual light-driven CO_2 assimilation by the PSII core complex in photosynthesis is found, which is likely to be a simultaneous event along with the normal CO_2 assimilation taking place in dark reaction.

Chin. J. Catal., 2023, 44: 127–138 doi: 10.1016/S1872-2067(22)64190-1

Investigation of nickel iron layered double hydroxide for water oxidation in different pH electrolytes

Qixian Xie, Dan Ren, Lichen Bai, Rile Ge, Wenhui Zhou, Lu Bai, Wei Xie, Junhu Wang *, Michael Grätzel, Jingshan Luo *
Nankai University, China;
École Polytechnique Fédérale de Lausanne (EPFL), Switzerland;
Dalian Institute of Chemical Physics, Chinese Academy of Sciences, China;

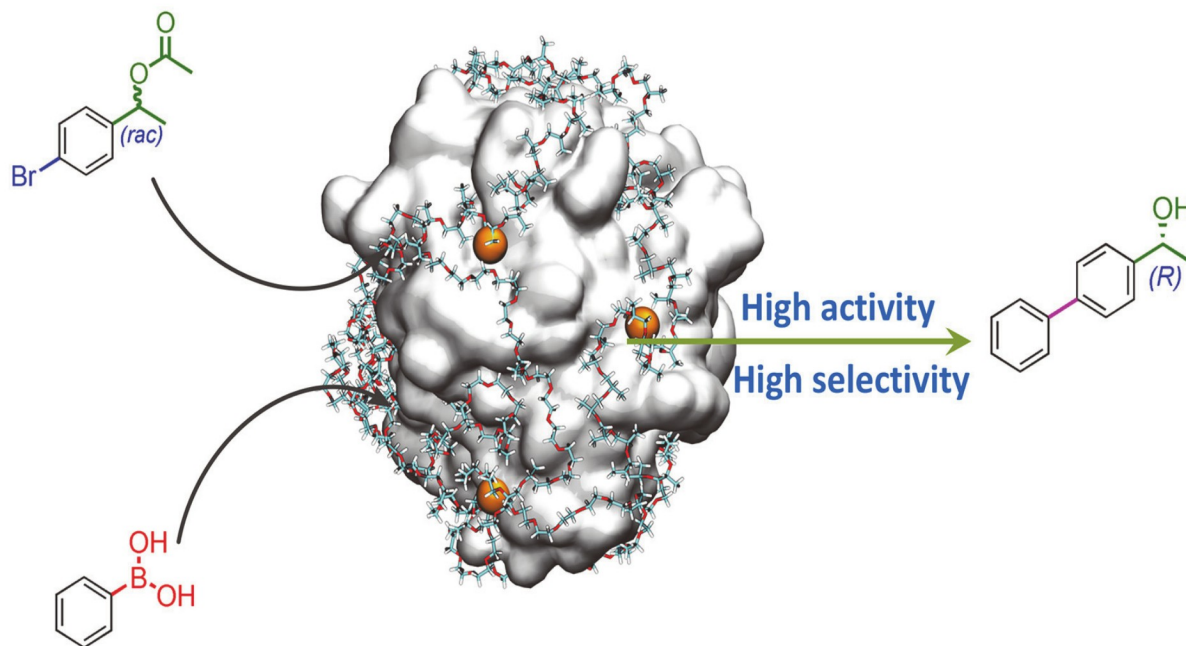


During the oxygen evolution reaction process, the rate determining step (RDS) of NiFe LDH catalysts in alkaline condition is from $\ast\text{O}$ to $\ast\text{OOH}$ while $\ast\text{OH}$ formation is the RDS in neutral condition.

Chin. J. Catal., 2023, 44: 139–145 doi: 10.1016/S1872-2067(22)64179-2

Enzyme-metal-single-atom hybrid catalysts for one-pot chemoenzymatic reactions

Xiaoyang Li, Yufei Cao, Jiarong Xiong, Jun Li, Hai Xiao *, Xinyang Li, Qingqiang Gou, Jun Ge *
Nanchang University; Tsinghua University;
SINOPEC (Beijing) Research Institute of Chemical Industry Co., Ltd.; Shenzhen Bay Laboratory



An one-pot chemoenzymatic cascade reaction to synthesize chiral alcohol is realized by using the highly active and selective enzyme-metal-single-atom hybrid as the catalyst. The enzyme-metal-single-atom hybrid catalyst provides a promising strategy for effectively merging the enzymatic and single-atom catalysis.

Chin. J. Catal., 2023, 44: 146–159 doi: 10.1016/S1872-2067(22)64155-X

Inter-plane 2D/2D ultrathin $\text{La}_2\text{Ti}_2\text{O}_7/\text{Ti}_3\text{C}_2$ MXene Schottky heterojunctions toward high-efficiency photocatalytic CO_2 reduction

Ke Wang, Miao Cheng, Nan Wang, Qianyi Zhang, Yi Liu, Junwei Liang, Jie Guan *, Maochang Liu *, Jiancheng Zhou, Naixu Li *
Southeast University; Xi'an Jiaotong University; Institute of Chemical Industry of Forest Products of the Chinese Academy of Forestry Sciences



A photocatalyst, which is efficient due to the combination of Ti_3C_2 , can achieve superior performance of CO_2 reduction to CO and CH_4 .

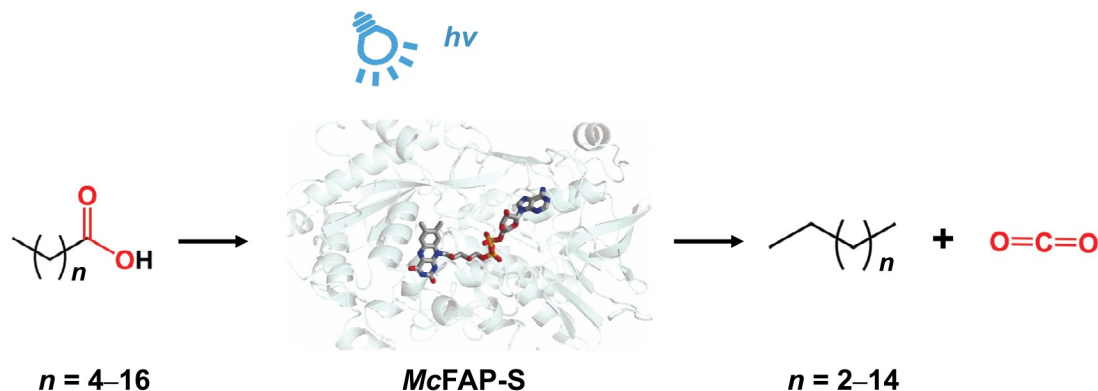
Chin. J. Catal., 2023, 44: 160–170 doi: 10.1016/S1872-2067(22)64173-1

A photodecarboxylase from *Micractinium conductrix* active on medium and short-chain fatty acids

Yunjian Ma, Xuanru Zhong, Bin Wu, Dongming Lan, Hao Zhang, Frank Hollmann*, Yonghua Wang*

South China University of Technology, China; Macau University of Science and Technology, China;

Delft University of Technology, The Netherlands; Guangdong Youmei Institute of Intelligent Bio-manufacturing Co., Ltd, China



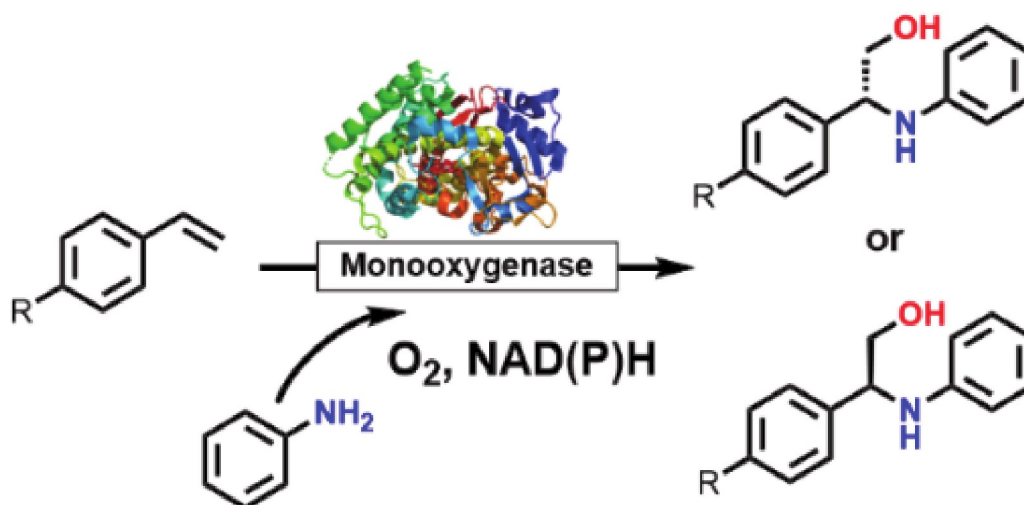
A photodecarboxylase from *Micractinium conductrix* active on medium and short-chain fatty acids shows unique chain carboxylic acids substrate selectivity compared to the well-known CvFAP.

Chin. J. Catal., 2023, 44: 171–178 doi: 10.1016/S1872-2067(22)64174-3

Biocatalytic aminohydroxylation of styrenes for efficient synthesis of enantiopure β -amino alcohols

Ruiwen Hu, Anjie Gong, Langxing Liao, Yan-Xin Zheng, Xin Liu, Peng Wu, Fushuai Li, Huili Yu, Jing Zhao, Long-Wu Ye*, Binju Wang*, Aitao Li*

Hubei University; Xiamen University



A general biocatalytic process of intermolecular aminohydroxylation of styrenes with aniline was developed in one-pot process, which provides an efficient, environmentally friendly approach for production of high value-added enantiopure β -amino alcohols, starting from cheap and readily available alkenes.

- [44] K. L. Tee, U. Schwaneberg, *Angew. Chem. Int. Ed.*, **2006**, 45, 5380–5383.
- [45] A. Li, J. Liu, S. Q. Pham, Z. Li, *Chem. Commun.*, **2013**, 49, 11572–11574.
- [46] S. Panke, B. Witholt, A. Schmid, M. G. Wubbolts, *Appl. Environ. Microbiol.*, **1998**, 64, 2032–2043.
- [47] X. Zhang, Y. Peng, J. Zhao, Q. Li, X. Yu, C. G. Acevedo-Rocha, A. Li, *Bioresour. Bioprocess.*, **2020**, 7, 2.
- [48] S. Kille, F. E. Zilly, J. P. Acevedo, M. T. Reetz, *Nat. Chem.*, **2011**, 3, 738–743.
- [49] R. J. Li, Z. Zhang, C. G. Acevedo-Rocha, J. Zhao, A. Li, *Green Synth. Catal.*, **2020**, 1, 52–59.
- [50] Y. Li, B. Yuan, Z. Sun, W. Zhang, *Green Synth. Catal.*, **2021**, 2, 267–274.
- [51] C. J. C. Whitehouse, S. G. Bella, L.-L. Wong, *Chem. Soc. Rev.*, **2012**, 41, 1218–1260.
- [52] J. R. Pliego, J. M. Riveros, *J. Phys. Chem. A*, **2001**, 105, 7241–7247.
- [53] B. Wang, Z. Cao, *J. Phys. Chem. A*, **2010**, 114, 12918–12927.
- [54] H. Zhou, B. Wang, F. Wang, X. Yu, L. Ma, A. Li, M. T. Reetz, *Angew. Chem. Int. Ed.*, **2019**, 58, 764–768.
- [55] W. Zhang, W. L. Tang, Z. Wang, Z. Li, *Adv. Synth. Catal.*, **2010**, 352, 3380–3390.
- [56] G. Qu, A. Li, C. G. Acevedo-Rocha, Z. Sun, M. T. Reetz, *Angew. Chem. Int. Ed.*, **2020**, 59, 13204–13231.

苯乙烯及其衍生物的生物氨羟化反应用于 β -氨基醇的高效合成

胡瑞文^{a,1}, 龚安界^{b,1}, 廖浪星^{b,1}, 郑颜欣^{b,1}, 刘鑫^b, 吴鹏^b, 李福帅^b, 郁慧丽^a,
赵晶^a, 叶龙武^{b,*}, 王斌举^{b,*}, 李爱涛^{a,*}

^a湖北大学生命科学学院, 工业生物技术湖北省重点实验室, 省部共建生物催化与酶工程国家重点实验室, 湖北武汉430062

^b厦门大学化学化工学院, 理论与计算化学福建省重点实验室, 固体表面物理化学国家重点实验室, 福建厦门360015

摘要: β -氨基醇是非常重要的手性砌块, 广泛用于药物、天然产物、氨基酸及其手性助剂的合成。迄今为止, 超过300000种含有此类结构单元的化合物已被报道, 其中包括2000多种天然产物、80多种已获批准的药物以及超过100种候选药物。鉴于 β -氨基醇的重要作用, 对映选择性高效合成 β -氨基醇具有非常重大的意义。过去几十年, 研究人员一直致力于 β -氨基醇高效合成方法的开发。其中, 通过利用过量的胺作为胺供体直接与环氧化物进行氨解反应, 是合成 β -氨基醇最为实用和认可的方法之一。此外, 科学家也开发了使用各种路易斯酸或不同有机溶剂中反应的化学法来提高环氧化物氨解反应的效率。然而, 这些方法普遍存在反应温度高、催化剂用量大、催化剂对水敏感以及有机溶剂危害大等缺陷。为了解决这些问题, 研究人员进一步开发出了水溶液体系中不依赖催化剂的环氧化物氨解反应, 用于氨基醇高效合成。但该方法仍然需要以高反应活性的环氧化物作为起始原料, 导致其在选择性控制和后期应用方面存在一定的问题。此外, 环氧化物(尤其是手性环氧化物)难以制备, 通常需要金属催化剂在苛刻的反应条件下进行。相比之下, 以廉价易得的烯烃作为底物, 通过Sharpless不对称胺羟化反应合成氨基醇是一种极具潜力的方法, 但该方法对许多类型烯烃如末端烯烃的催化活性很低。

针对上述问题, 本文发展了一种酶法催化烯烃不对称氨羟化反应, 采用一锅法合成光学纯的 β -氨基醇, 它以血红素依赖性细胞色素P450单加氧酶或黄素(FAD)依赖性苯乙烯单加氧酶作为催化剂。首先, 催化烯烃不对称环氧化生产手性环氧化物中间体, 然后利用苯胺作为胺供体与环氧化物发生自发的化学氨解反应, 从而合成相应光学纯的 β -氨基醇。利用cluster-continuum(HCC)模型计算结合实验研究了环氧化物中间体与苯胺的氨解机理以及水分子在该反应中的关键作用。结果表明, 产物 β -氨基酸的光学纯度是由酶促反应中形成的环氧化物的绝对构型所决定。基于此, 本文发掘了具有不同立体选择性的P450单加氧酶或苯乙烯单加氧酶, 用于催化苯乙烯和苯胺的氨羟化反应, 并对反应条件, 包括底物浓度、胺供体浓度以及底物添加方式进行优化, 分别高效地合成了(*S*)-和(*R*)-构型的两种氨基醇, 得率均为90%, 产物的 ee 值分别为90%和99%。最后, 对该生物催化体系进行了底物谱的拓展, 用于催化苯乙烯及其衍生物与苯胺的分子间的氨羟化反应, 实现了多种相应(*R*)-或(*S*)-构型 β -氨基醇的高效合成, 得率为87%–97%, ee 值为90%–99%。综上, 本文开发的人工生物催化体系, 为光学纯的 β -氨基醇的高效合成提供了一种高效、绿色环保的新策略。

关键词: 氨羟化反应; β -氨基醇; 烯烃单加氧酶; 环氧化物氨解; 化学酶反应

收稿日期: 2022-07-23. 接受日期: 2022-09-21. 上网时间: 2022-12-10.

*通讯联系人. 电子信箱: aitaoli@hubu.edu.cn (李爱涛), wangbinju2018@xmu.edu.cn (王斌举), longwuyue@xmu.edu.cn (叶龙武).

¹共同第一作者.

基金来源: 国家重点研发计划(2019YFA0906400); 湖北省生物催化与酶工程技术引智创新示范基地项目(2019BJH021); 省部共建生物催化与酶工程国家重点实验室自主研发项目.