

Green Chemistry

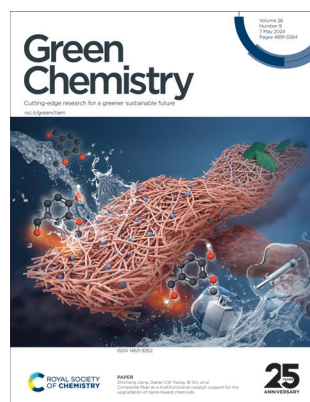
Cutting-edge research for a greener sustainable future

rsc.li/greenchem

The Royal Society of Chemistry is the world's leading chemistry community. Through our high impact journals and publications we connect the world with the chemical sciences and invest the profits back into the chemistry community.

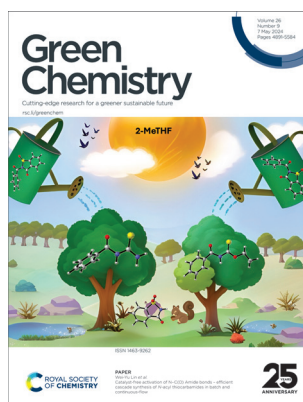
IN THIS ISSUE

ISSN 1463-9262 CODEN GRCHFJ 26(9) 4891-5584 (2024)



Cover
See Zhicheng Jiang, Daniel CW Tsang, Bi Shi, et al., pp. 5178–5186.

Image reproduced by permission of Zhicheng Jiang from *Green Chem.*, 2024, **26**, 5178.



Inside cover
See Wei-Yu Lin et al., pp. 5187–5193.

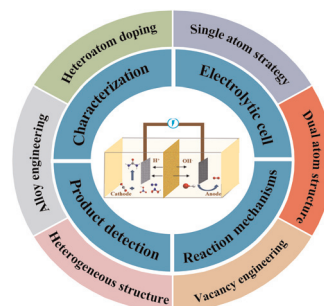
Image reproduced by permission of Karthick Govindan, Nian-Qi Chen, Wei-Yu Lin from *Green Chem.*, 2024, **26**, 5187.

CRITICAL REVIEWS

4908

Electrocatalytic C–N coupling for urea synthesis: a critical review

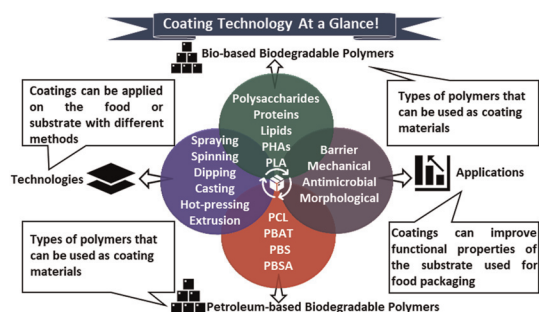
Chuanju Yang, Zhe Li, Junpeng Xu, Yujing Jiang and Wenlei Zhu*



4934

Sustainable biodegradable coatings for food packaging: challenges and opportunities

Fatemeh Jahangiri, Amar K. Mohanty and Manjusri Misra*



RSC Sustainability

GOLD
OPEN
ACCESS

Dedicated to sustainable
chemistry and new solutions

For an open, green and inclusive future

rsc.li/RSCSus

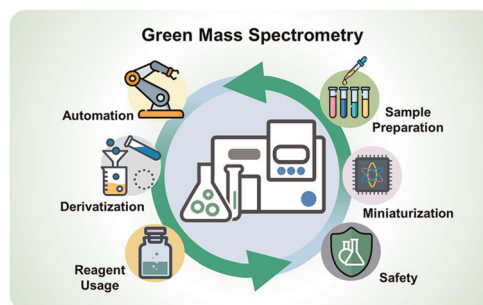
Fundamental questions
Elemental answers

TUTORIAL REVIEWS

4975

Mass spectrometry in the age of green analytical chemistry

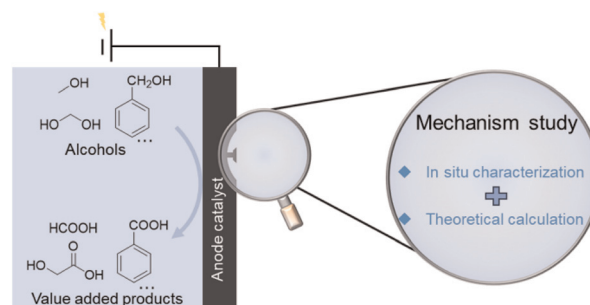
Yuchen Zou, Weiwei Tang and Bin Li*



4987

Recent progress in transition metal based catalysts and mechanism analysis for alcohol electrooxidation reactions

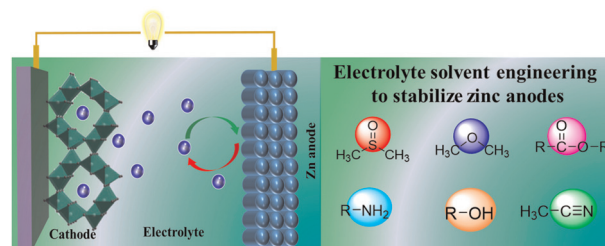
Yuguo Zhao, Emma M. Björk, Yong Yan,* Peter Schaaf and Dong Wang*



5004

Progress in stabilizing zinc anodes for zinc-ion batteries using electrolyte solvent engineering

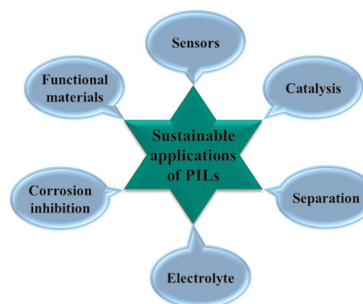
Le Li, Shi Yue, Shaofeng Jia, Conghui Wang, Hengwei Qiu, Yongqiang Ji, Minghui Cao* and Dan Zhang*



5022

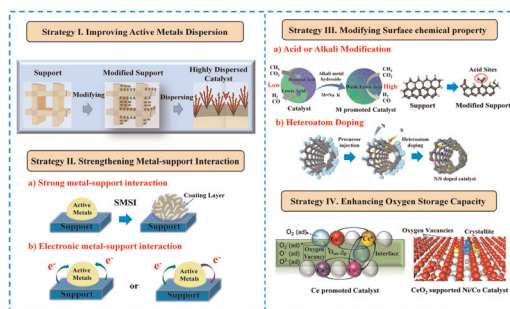
Poly(ionic liquid)s: an emerging platform for green chemistry

Maiyong Zhu* and Yu Yang



TUTORIAL REVIEWS

5103

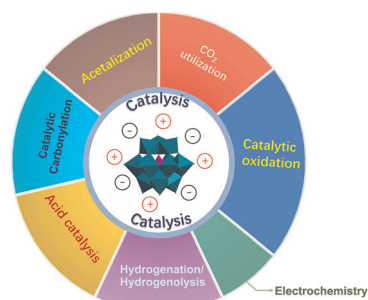


Recent advances in the design of high-performance cobalt-based catalysts for dry reforming of methane

Yinghui Sun,* Yanbin Zhang, Xifei Yin, Chenghu Zhang, Ying Li and Jie Bai*

PERSPECTIVE

5127

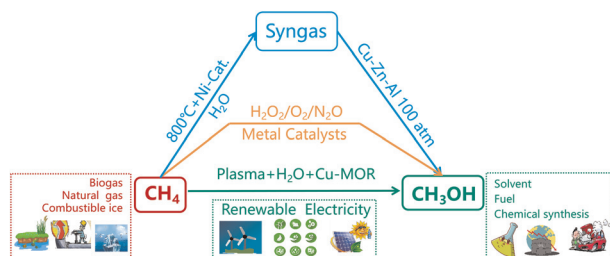


Ionic liquid-stabilized metal oxoclusters: from design to catalytic application

Yunxiang Qiao, Enting Shi, Xinjia Wei and Zhenshan Hou*

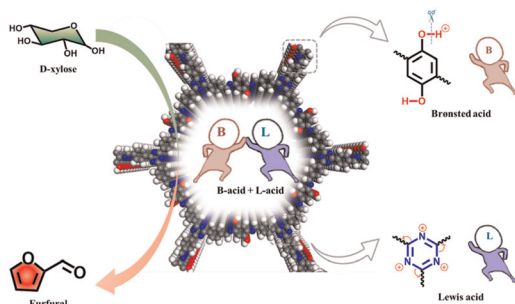
COMMUNICATIONS

5150

Plasma-catalytic one-step steam reforming of CH₄ to CH₃OH and H₂ promoted by oligomerized [Cu-O-Cu] species on zeolites

Wei Fang, Ximiao Wang, Shangkun Li, Yingzi Hao, Yuping Yang, Wenping Zhao, Rui Liu, Dongxing Li, Chuang Li, Xiaoxia Gao, Li Wang, Hongchen Guo and Yanhui Yi*

5155



One-pot furfural production from sustainable biomass-derived sugars using a functionalized covalent organic framework as a heterogeneous catalyst

Peng Gan, Kai Zhang,* Zhihao Li, Chengxiang Zhang, Guihua Yang,* Lei Zhang, Baobin Wang and Jiachuan Chen*

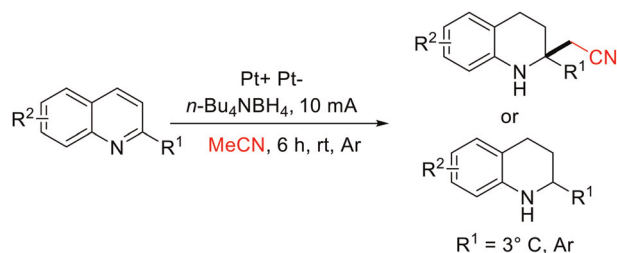


COMMUNICATIONS

5160

Synthesis of tetrahydroquinoline derivatives via electrochemical hydrocyanomethylation or hydrogenation of quinolines with MeCN

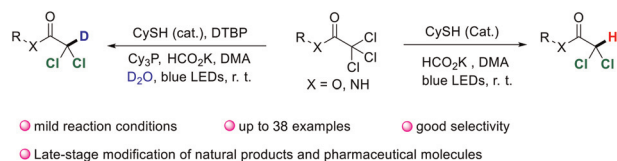
Jie Xia, Dahan Wang,* Ruitong Yang, Yujie Deng and Guo-Jun Deng*



5167

Photocatalytic organosulfur reagent-promoted selective mono-(deutero)hydrodechlorination

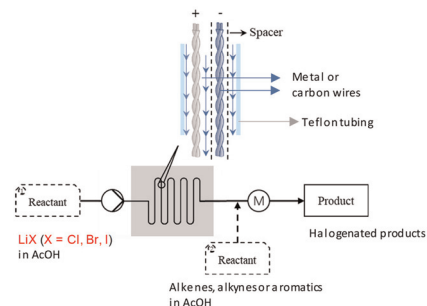
Junlei Wang,* Guocheng Gao, Jiadong Cheng, Jintao Li, Xiaoshuang Chen, Xuemei Chen, Daohai Zhang, Hongqing Li,* Xiaohua Cai and Binbin Huang*



5173

A continuous flow electrochemical reactor using readily available metal wires and carbon fibers as electrodes: environmentally benign halogenations of alkenes, alkynes, and aromatics

Yinqing Xie, Long Lin and Bo Xu*



PAPERS

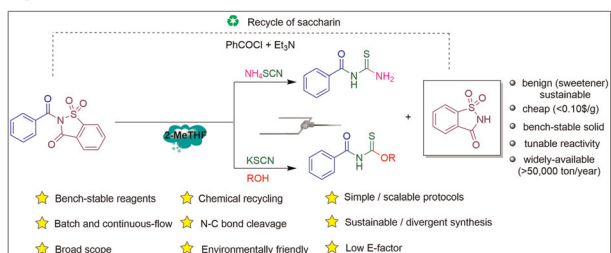
5178

Composite fiber as a multifunctional catalyst support for the upgradation of lignin-based chemicals

Zuzhi Li, Ya Ma, Xingjie Guo, Yang Cao, Qian Jiang, Mi Gao, Xudong Liu, Daniel C. W. Tsang,* Zhicheng Jiang* and Bi Shi



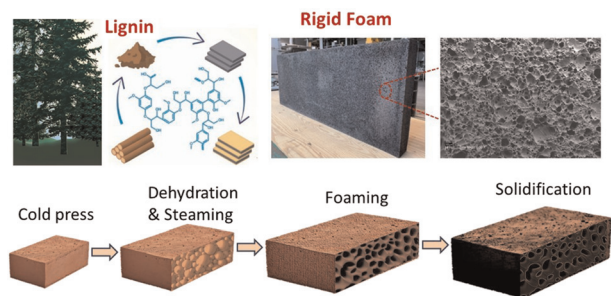
5187



Catalyst-free activation of N–C(O) Amide bonds – efficient cascade synthesis of N-acyl thiocarbamides in batch and continuous-flow

Karthick Govindan, Nian-Qi Chen and Wei-Yu Lin*

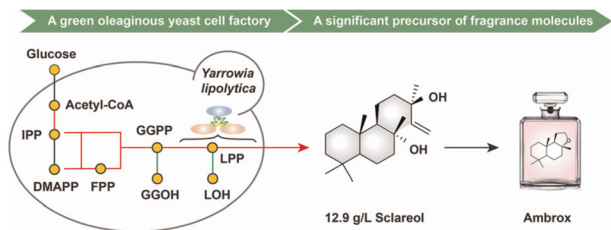
5194



Eco-foaming lignin for innovative rigid foam

Qiangyu Yan, Timothy Ketelboeter, Wenjun Fan, Caixia Wan* and Zhiyong Cai*

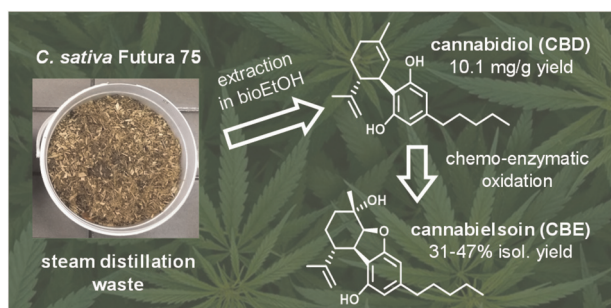
5202



Constructing a green oleaginous yeast cell factory for sustainable production of the plant-derived diterpenoid sclareol

Mei-Li Sun, Yuting Han, Xiao Yu, Kaifeng Wang, Lu Lin, Rodrigo Ledesma-Amaro and Xiao-Jun Ji*

5211



Valorisation of the industrial hemp residue from essential oil production by recovery of cannabidiol and chemo-enzymatic conversion to cannabielsoin

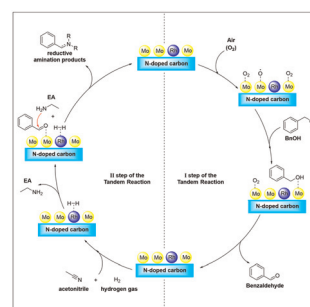
Daniele Fiorito, Davide Tessaro, Fabio Sangalli, Celeste Nobbio, Mario Nebuloni, Matteo Vezzini, Elisabetta Brenna and Fabio Parmeggiani*



5221

Orthogonal assisted tandem reactions for the upgrading of bio-based aromatic alcohols using chitin derived mono and bimetallic catalysts

Francesco Zorzetto, Daniel Ballesteros-Plata, Alvise Perosa, Enrique Rodríguez-Castellón, Maurizio Selva* and Daily Rodríguez-Padrón*



5239

Interactions of multiple metrics and environmental indicators to assess processes, detect environmental hotspots, and guide future development

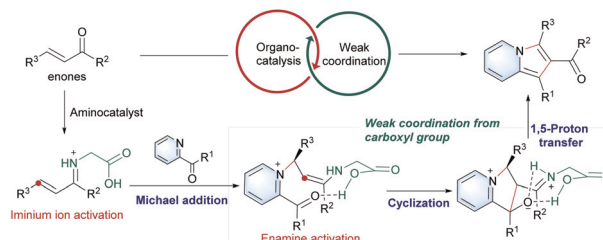
Michael U. Luescher* and Fabrice Gallou



5253

Weak-coordination-auxiliary aminocatalysis enables directed [3 + 2] cyclization for 2-acylindolizines

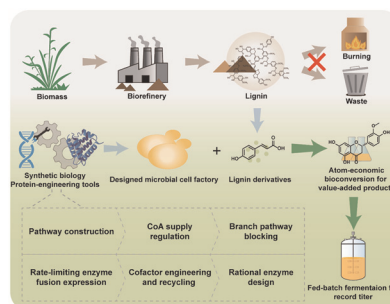
Kui Zeng, Neeraj Kumar Pandit, João C. A. Oliveira, Sebastian Dechert, Lutz Ackermann* and Kai Zhang*



5260

Pathway and enzyme engineering for the bioconversion of lignin derivatives into homoeriodictyol in *Saccharomyces cerevisiae*

Si-Yu Zhu, Shi-Chang Liu, Chuan-Xi Zhang, Xin Xin, Zhi-Hua Liu, Lu-Jia Zhang, Bing-Zhi Li* and Ying-Jin Yuan



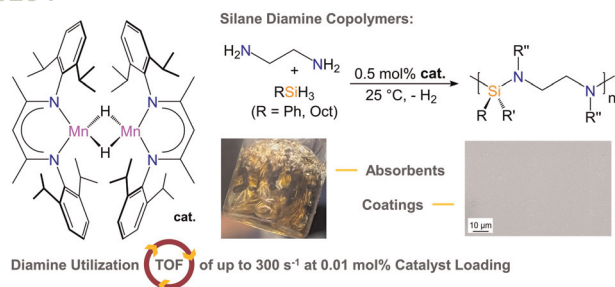
5273



Comparative environmental assessment of zeolites synthesized from chemicals and natural minerals

Xiaoling Chen, Guoxi Xiao, Tiesen Li,* Chan Wang, Qingyan Cui, Xiaojun Bao and Yuanyuan Yue*

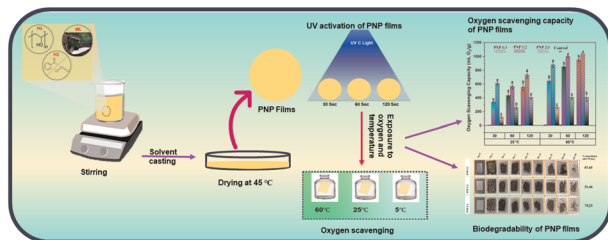
5284



Silane diamine copolymers: efficient synthesis, solvent absorption capacity, and limitations as coatings

Thao T. Nguyen, Anuja Sharma, Tam Le Phuong Nguyen, Michael A. Trimble, Dong-Kyun Seo and Ryan J. Trovitch*

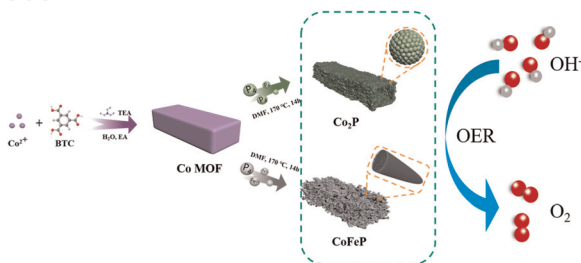
5293



Ultra-violet light-driven green oxygen scavenging composite made of PVA/NRL for active packaging: an alternative to metallic oxygen scavengers

Dakuri Ramakanth, Konala Akhila, Bittu Prudhvi Kumar, Kirtiraj K. Gaikwad* and Pradip K. Maji*

5308



Iron-doped cobalt phosphide nanowires prepared via one-step solvothermal phosphidization of metal–organic frameworks for the oxygen evolution reactions

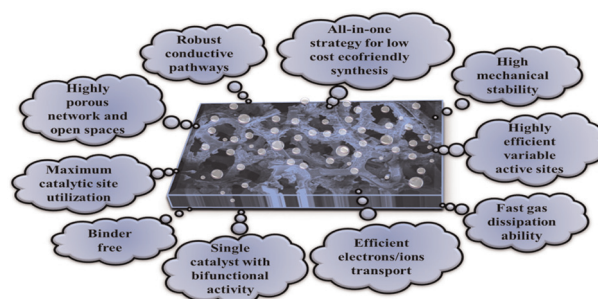
Jianbo Tong,* Yichuang Xing, Xuechun Xiao, Yuan Liu, Zhikai Hu, Zeyi Wang, Yanling Hu, Bowen Xin, Shuling Liu, He Wang* and Chao Wang*



5326

In situ hierarchical self-assembly of NiFeHCF nanoparticles on nickel foam: highly active and ultra-stable bifunctional electrocatalysts for water splitting and their environmental assessment towards green energy

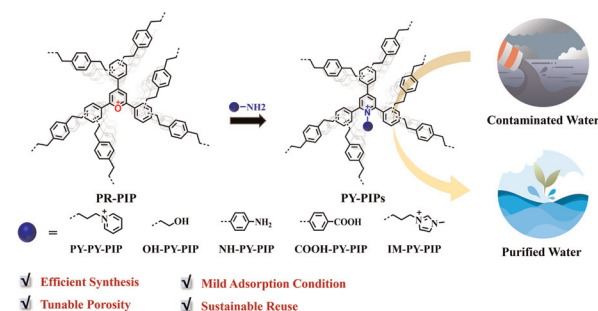
Arunagiri Gayathri, Venkatachalam Ashok, Muthukumar Sangamithirai, Jayaraman Jayabharathi and Venugopal Thanikachalam*



5339

Construction of a tunable pyrylium based porous ionic polymer network for efficient waterborne pollutant treatment

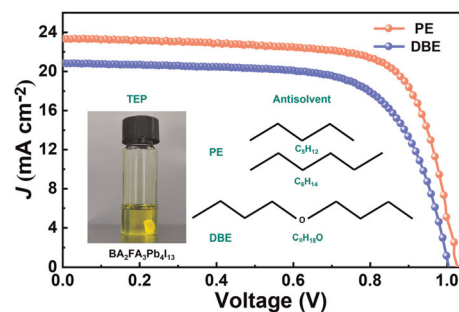
Xueye Zhu, Jiayu Han, Zhiwei Chen, Zheng Shi, Jiamin Zhang and Siyu Guo*



5347

Antisolvent effects in green solvent engineering of FA-based quasi-2D Ruddlesden–Popper perovskite films for efficient solar cells

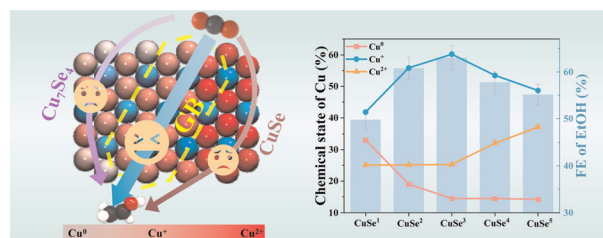
Guoshuai Zhang, Jun Tang, Chenming Wang, Xianyao Wu, Jie Chen, Xi Wang, Kai Wang, Xixiang Zhu, Haomiao Yu and Jinpeng Li*



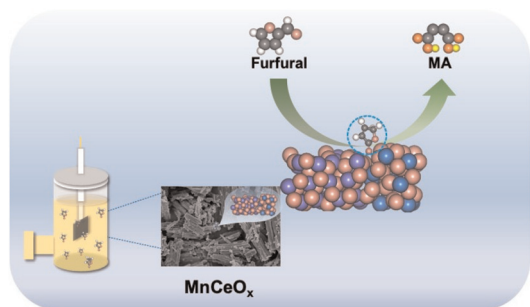
5356

Grain boundaries assisting the generation of abundant Cu⁺ for highly selective electroreduction of CO₂ to ethanol

Xinze Bi, Yuezhu Zhao, Yifan Yan, Hongzhi Wang* and Mingbo Wu*



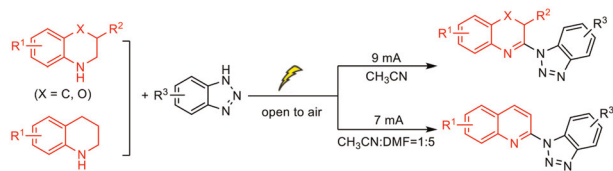
5365



Highly efficient electrocatalytic oxidation of furfural to maleic acid over MOF-derived MnCeO_x

Xue Yuan, Xin Huang,* Meimin Hu, Jinjia Liu,*
Wenhao Guo, Yuchen Hao, Zhenting Li, Kai Zhang and
Buxing Han*

5371

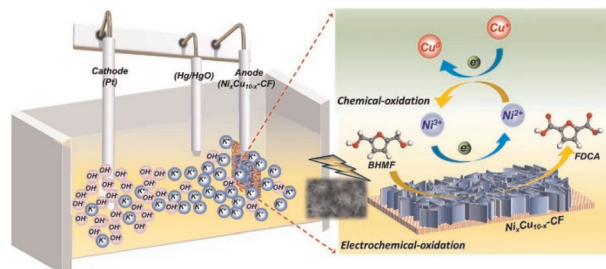


- mild and green conditions
- insensitive to air
- atomic economy
- suitable for structurally diverse benzotriazoles
- broad functional group tolerance
- diversity of products

Electrochemical oxidative cross-coupling of tetrahydroquinolines and azoles

Dan Yang, Yu-Fang Tan, Ya-Nan Zhao, Jin-Feng Lv,
Zhi Guan* and Yan-Hong He*

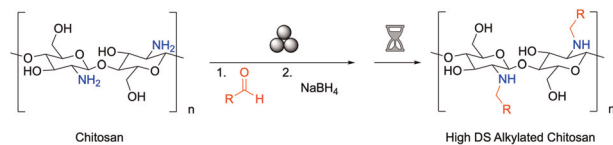
5377



Interaction between copper and nickel species for electrooxidation of 2,5-bis(hydroxymethyl)furan

Peiyuan Liu, Liyuan Huai, Bin Zhu, Yang Zhong,
Jian Zhang* and Chunlin Chen*

5386



- No dissolution
- No heating
- Wide scope
- PMI 36

Mechanochemical and aging-based reductive amination with chitosan and aldehydes affords high degree of substitution functional biopolymers

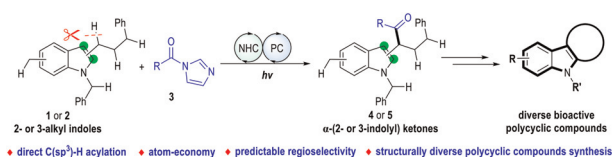
Galen Yang, Sophie Régnier, Noah Huin, Tracy Liu,
Edmond Lam* and Audrey Moores*



5397

N-heterocyclic carbene and photocatalyst-catalyzed rapid access to indole ketones via radical C(sp³)-H acylation

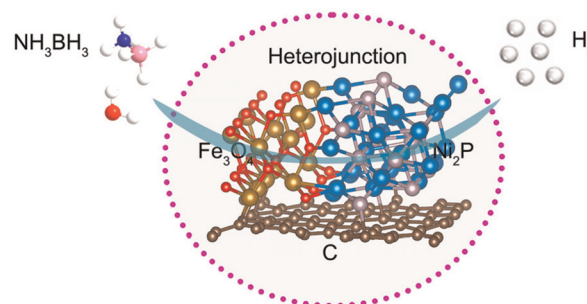
Guihua Nie, Ting Tu, Tianhui Liao, Donghan Liu, Wenjun Ye and Shi-Chao Ren*



5409

In situ formed nickel phosphide/iron oxide heterojunction for accelerating hydrogen generation

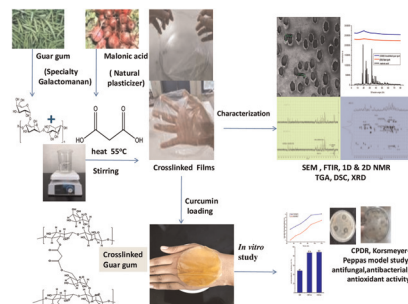
Wenjing Xu,* Wei Li, Wei Chen, Mei Liu, Xianji Guo and Baojun Li*



5417

Galactomannan crosslinking with a green plasticizer malonic acid and its biomedical applications

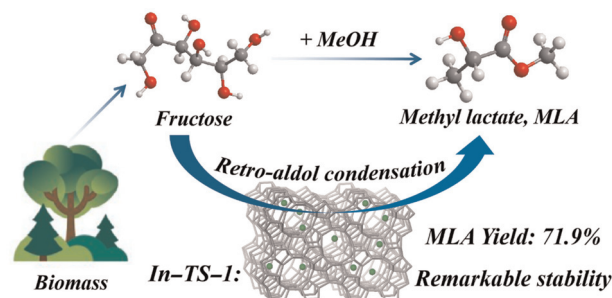
Jyoti Rajput, Vineet Kumar,* Kalpana Chauhan, Vipin Parkash and Sushil Bhattarai



5433

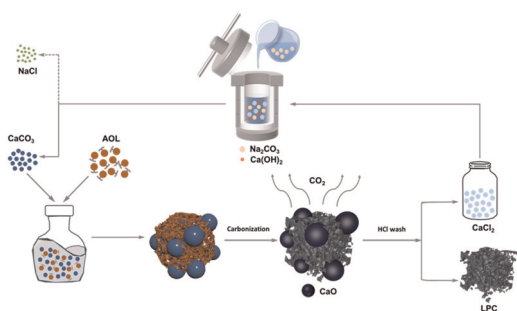
An encapsulation strategy to design an In-TS-1 zeolite enabling high activity and stability toward the efficient production of methyl lactate from fructose

Yuxi Jiang, Xilei Lyu,* Chao Chen, Aotian Ren, Wenqi Qin, Hao Chen* and Xiuyang Lu*



PAPERS

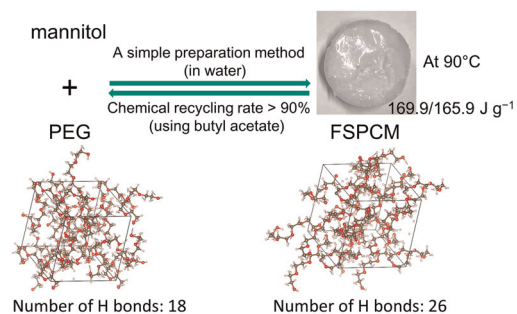
5441



Sustainable lignin-derived hierarchical mesoporous carbon synthesized by a renewable nano-calcium carbonate hard template method and its utilization in zinc ion hybrid supercapacitors

Jiahao Zhu, Tao Huang, Manjia Lu, Xueqing Qiu* and Wenli Zhang*

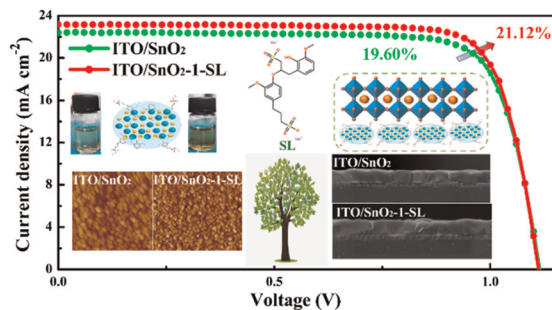
5452



A form-stable phase change material based on intermolecular hydrogen bonding with a high chemical recycling rate

Xinyi Shen, Yulin Liu, Na Li, Haiyan Ju,* Xiaowei Fu, Liang Jiang, Yao Xiao,* Ping He* and Jingxin Lei*

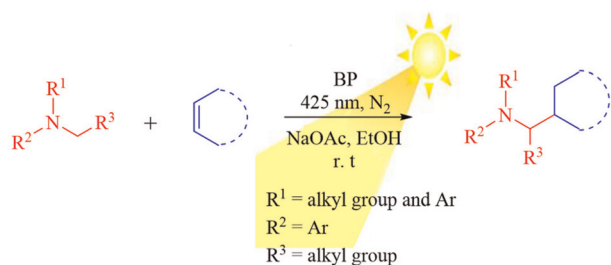
5460



Performance enhancement of perovskite solar cells by doping non-toxic multifunctional natural sodium liginosulfonate into SnO₂

Zezhuan Jiang, Fuling Li, Huaiqing Yan, Rathes Kannan R, Lijia Chen, Ping Li* and Qunliang Song*

5471



Photocatalytic α -aminoalkyl radical addition of amines mediated by benzophenone under visible light

Jinke Chen, Qi Lian, Xinru Jiang, Juan Zhang, Xiang Luo,* Jiansong Fang* and Wentao Wei*

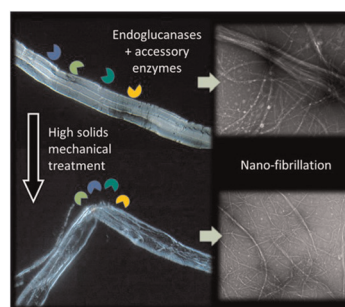


PAPERS

5477

Production of lignin containing cellulose nanofibrils (CNF) after enzymatic treatment of curl-induced, unbleached kraft pulps

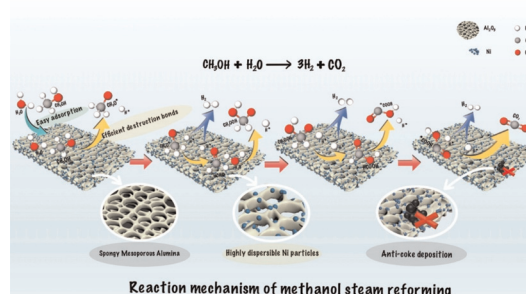
Jie Wu, Yintian Dong, Xia Sun, Peipei Wang, Jiaying Zhu, Yeling Zhu, Feng Jiang and Jack Saddler*



5485

Enhancement of hydrogen production via methanol steam reforming using a Ni-based catalyst supported by spongy mesoporous alumina

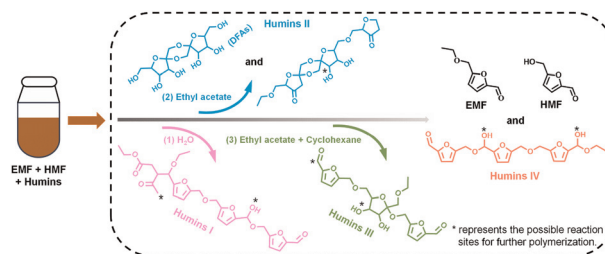
Bin Hu, Riyang Shu,* Zhipeng Tian, Chao Wang, Ying Chen and Ying Xu*



5499

Sequential extraction and separation of soluble humins from fructose conversion for structural and evolutionary understanding

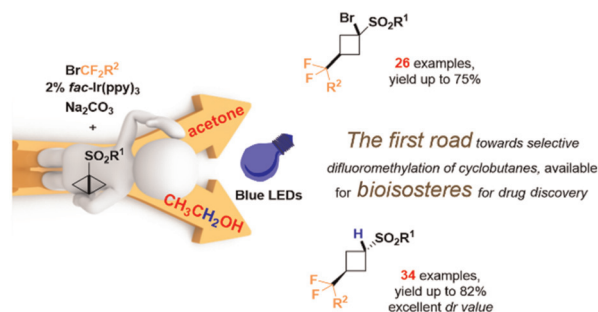
Hui Li, Yexin Hu, Ping Hu, Linzhen Li, Di Wu, Zhidan Xue, Changwei Hu and Liangfang Zhu*



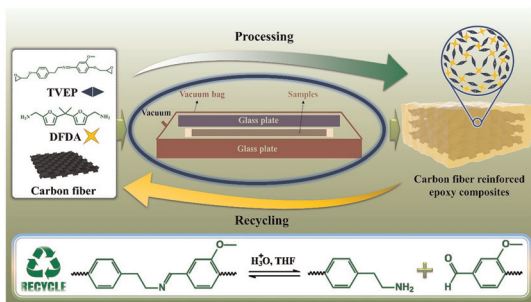
5512

Photochemical selective difluoroalkylation reactions of bicyclobutanes: direct sustainable pathways to functionalized bioisosteres for drug discovery

Yunxin Duan, Yerong Xu, Yunzhe Li, Lin Mao, Jianquan Feng, Ruyue Zhang, Weifang Tang, Tao Lu,* Yadong Chen* and Jie Feng*



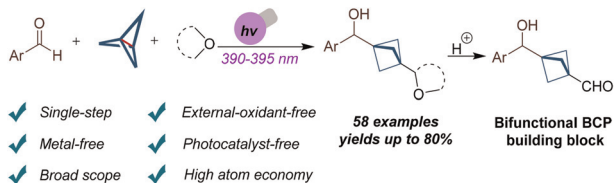
5519



High biomass content, anti-flammable and degradable epoxy thermosets by curing a tyramine-derived epoxy monomer with a furan-derived diamine for non-destructively recyclable carbon fiber composite application

Hao-Xin Niu, Tian-Mo Yang, Xin Wang,* Ping Zhang, Wenwen Guo, Lei Song and Yuan Hu*

5531



- ✓ Single-step
- ✓ External-oxidant-free
- ✓ Metal-free
- ✓ Photocatalyst-free
- ✓ Broad scope
- ✓ High atom economy

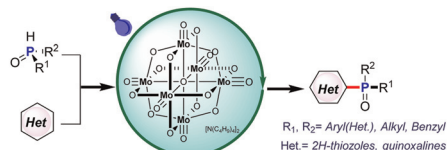
58 examples
yields up to 80%

Bifunctional BCP
building block

Metal- and photocatalyst-free three-component strategy to prepare benzylalcohol-, aldehyde-substituted BCP building blocks

Fei Li, Huijuan Liao, Jianyang Dong, Weikang Xiong, Yonggang Yan, Gang Li and Dong Xue*

5538

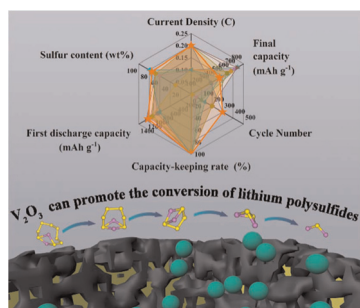


- ✓ Inorganic ligand-supported Mo oxide as HAT photocatalyst for the formation of C(sp²)-P bonds
- ✓ Gram-scale reactivity with low catalyst loading
- ✓ Photo-reactivity under sunlight irradiation
- ✓ Water-based solvent, air as green oxidant
- ✓ Catalyst reusability and stability

Inorganic ligand-supported Mo oxide as a hydrogen atom transfer photocatalyst for direct C(sp²)-H phosphorylation

Zeqi Jiang,* Shuangfei Jiang, Jin Gao, Junmei Xia, Hongwei Yu, Lixin Ma, Xi Chen, Bo Chen, Xinghua Zhang* and Wenchao Zhu*

5546



Conductive V₂O₅ electrocatalyst on carbon hollow spheres to accelerate polysulfide conversion for long-cycle and high-rate lithium sulfur batteries

Jiangnan Zhang, Mingjun Xiao,* Tingting Liu, Yanshuang Meng, Fuliang Zhu* and Zhaoyang Fan*



5556

Preparation of chemically recyclable bio-based semi-aromatic polyamides using continuous flow technology under mild conditions

Yirong Feng, Xiaowei Li, Tingting Ma, Yuguang Li, Dong Ji, Hong Qin, Zheng Fang, Wei He* and Kai Guo*



5564

Carbonic anhydrase assisted acidogenic fermentation of forest residues for low carbon hydrogen and volatile fatty acid production: enhanced *in situ* CO₂ reduction and microbiological analysis

Omprakash Sarkar,* Io Antonopoulou,* Charilaos Xiros, Ylva Bruce, Sarra Souadkia, Ulrika Rova, Paul Christakopoulos and Leonidas Matsakas*

