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 25(20) 7829-8296 (2023)



See Wei-Min He et al., pp. 7983-7987.

Image reproduced by permission of Wei-Min He from Green Chem., 2023. 25. 7983.



Inside cover

See Zongjie Dai et al., pp. 7988-7997.

Image reproduced by permission of Zongjie Dai from Green Chem., 2023, 25, 7988.

TUTORIAL REVIEWS

7843

Sacrifice and valorization of biomass to realize energy exploitation and transformation in a photoelectrochemical way

Daobin Tang, Jianguo Liu,* Xinghua Zhang, Lungang Chen, Longlong Ma and Qi Zhang*



Physico-chemical challenges on the self-assembly of natural and bio-based ingredients on hair surfaces: towards sustainable haircare formulations

Gustavo S. Luengo,* Fabien Leonforte, Andrew Greaves, Ramon G. Rubio and Eduardo Guzman*



Executive Editor Michael A. Rowan

Editorial Staff

Deputy Editor

Development Editors

Bee Hockin, Andrea Carolina Ojeda Porras

Editorial Production Manager

Gisela Scott

Publisher

eanne Andres

Senior Publishing Editor

Robin Brabham

Publishing Editors

Catherine Au, Isobel Darlington, Konoya Das, Alexandre Dumon, Amy Lucas, Kieran Nicholson, Rini Prakash, Charlotte Pugsley, Hugh Ryan

Editorial Assistant

Publishing Assistant

Robert Griffiths

For queries about submitted articles please contact Gisela Scott, Editorial Production Manager, in the first instance. E-mail green@rsc.org

For pre-submission queries please contact Michael A. Rowan, Executive Editor.

E-mail green-rsc@rsc.org

Green Chemistry electronic: ISSN 1463-9270 is published 24 times

a year by the Royal Society of Chemistry,

Thomas Graham House, Science Park, Milton Road, Cambridge, CB4 0WF, UK.

All orders, with cheques made payable to the Royal Society of Chemistry, should be sent to the Royal Society of Chemistry Order Department, Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, CB4 0WF, UK

Tel +44 (0)1223 432398; E-mail orders@rsc.org

2023 Annual electronic subscription price: £2578; US\$4544. Customers in Canada will be subject to a surcharge to cover GST. Customers in the EU subscribing

to the electronic version only will be charged VAT.

If you take an institutional subscription to any Royal Society of Chemistry journal you are entitled to free, site-wide web access to that journal. You can arrange access via Internet Protocol (IP) address at www.rsc.org/ip

Customers should make payments by cheque in sterling payable on a UK clearing bank or in US dollars payable on a US clearing bank.

Whilst this material has been produced with all due care, the Royal Society of Chemistry cannot be held responsible or liable for its accuracy and completeness, nor for any consequences arising from any errors or the use of the information contained in this publication. The publication of advertisements does not constitute any endorsement by the Royal Society of Chemistry or Authors of any products advertised. The views and opinions advanced by contributors do not necessarily reflect those of the Royal Society of Chemistry which shall not be liable for any resulting loss or damage arising as a result of reliance upon this material. The Royal Society of Chemistry is a charity, registered in England and Wales, Number 207890, and a company incorporated in England by Royal Charter (Registered No. RC000524), registered office: Burlington House, Piccadilly, London W1J 0BA, UK, Telephone: +44 (0) 207 4378 6556.

Advertisement sales:

Tel +44 (0) 1223 432246; Fax +44 (0) 1223 426017; E-mail advertising@rsc.org

For marketing opportunities relating to this journal, contact marketing@rsc.org



Green Chemistry

Cutting-edge research for a greener sustainable future

rsc.li/greenchem

Green Chemistry focuses on cutting-edge research that attempts to reduce the environmental impact of the chemical enterprise by developing a technology base that is inherently non-toxic to living things and the environment.

Editorial Board

Chair

Professor Doctor Javier Pérez-Ramírez, ETH Zurich, Switzerland

Associate Editor

Professor Aiwen Lei, College of Chemistry and Molecular Sciences, The Institute for Advanced Studies, Wuhan University, P. R. China Dr Elsje A. Quadrelli, CNRS and CPE Lyon, France

Professor Magdalena Titirici, Imperial College London, UK

Dr Keiichi Tomishige, Tohoku Univeristy, Japan

Members

Professor André Bardow, ETH Zurich, Switzerland

Dr François Jérôme, University of Poitiers, France

Professor Laurel Shafer, The University of British Columbia, Canada Dr Helen Sneddon, University of York, UK Dr Tao Zhang, Dalian Institute of Chemical Physics, Chinese Academy of Sciences, China

Advisory Board

Paul Anastas, Yale University, USA Isabel Arends, TU Delft, The Netherlands Gregg Beckham, NREL, USA

Asim Bhaumik, Indian Association for the Cultivation of Science, India Fabrizio Cavani, University of Bologna, Italy

James Clark, University of York, UK Avelino Corma, Universidad Politecnica de Valencia, Spain Robert H Crabtree, Yale University, USA

Paul Dauenhauer, University of Minnesota, USA

James Dumesic, University of Wisconsin-Madison, USA

Martin Eastgate, Bristol Myers Squibb, USA Karen Goldberg, University of Washington, USA

Buxing Han, Chinese Academy of Sciences, China Steve Howdle, Nottingham University ,UK

Steve Howdle, Nottingham University ,UK Andrew J. Hunt, Khon Kaen University, Thailand Graham Hutchings, Cardiff University, UK Philip Jessop, Queen's University, Canada C. Oliver Kappe, University of Graz, Austria Shu Kobayashi, University of Tokyo, Japan Burkhard Koenig, University of Regensburg, Germany

Michael Kopach, Eli Lilly and Company, USA Walter Leitner, RWTH Aachen University, Germany

Chao-Jun Li, McGill University, Canada Bruce Lipshutz, University of California, USA Doug MacFarlane, Monash University, Australia Tomoo Mizugaki, Osaka University, Japan

Regina Palkovits, RWTH Aachen, Germany Alvise Perosa, Universita Ca Foscari, Italy Martina Peters, Bayer AG, Germany Martyn Poliakoff, University of Nottingham, UK

Colin Raston, Flinders University, Australia Chemistry Faculty/School of Su Roberto Rinaldi, Imperial College London, UK Leuphana University, Germany Robin D. Rogers, McGill University, Canada

Susannah Scott, University of California, USA Roger Sheldon, Delft University of Technology, The Netherlands

Christian Stevens, Ghent Univesity, Belgium Natalia Tarasova, Mendeleev University of Chemical Technology, Russia

Rajender Varma, US Environmental Protection Agency, USA Tom Welton, Imperial College London, UK

Kevin C. W. Wu, National Taiwan University, Taiwan Ganapati D. Yadav. Institute of Chemical

Ganapati D. Yadav, Institute of Chemical Technology, India

Hisao Yoshida, Kyoto University, Japan Suojiang Zhang, Institute of Process Engineering, Chinese Academy of Sciences, China

Julie Zimmerman, Yale University, USA Vånia Zuin Zeidler, Institute of Sustainable Chemistry Faculty/School of Sustainability, Leuphana University, Germany

Information for Authors

Full details on how to submit material for publication in Green Chemistry are given in the Instructions for Authors (available from http://www.rsc.org/authors). Submissions should be made via the journal's homepage: rsc.li/greenchem

Authors may reproduce/republish portions of their published contribution without seeking permission from the Royal Society of Chemistry, provided that any such republication is accompanied by an acknowledgement in the form: (Original Citation)–Reproduced by permission of the Royal Society of Chemistry.

This journal is © The Royal Society of Chemistry 2023. Apart from fair dealing for the purposes of research or private study for non-commercial purposes, or criticism or review, as permitted under the Copyright, Designs and Patents Act 1988 and the Copyright and Related Rights Regulation 2003, this publication may only be reproduced, stored or transmitted, in any form or by any means, with the prior permission in writing of the Publishers or in the case of reprographic reproduction in accordance with the terms of licences issued by the Copyright Licensing Agency in the UK. US copyright law is applicable to users in the USA.

Registered charity number: 207890

TUTORIAL REVIEWS

7883

Research status, opportunities, and challenges of cobalt phosphate based materials as OER electrocatalysts

Xingheng Zhang, Qi Hou, Shoufu Cao, Xiaojing Lin, Xiaodong Chen, Zhaojie Wang,* Shuxian Wei, Siyuan Liu, Fangna Dai and Xiaoqing Lu*

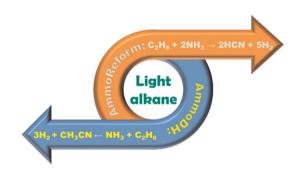


PERSPECTIVE

7904

Ammonia-assisted reforming and dehydrogenation toward efficient light alkane conversion

Yizhi Xiang

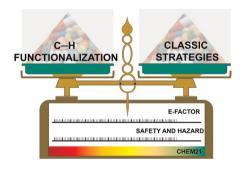


CRITICAL REVIEWS

7916

Classic vs. C-H functionalization strategies in the synthesis of APIs: a sustainability comparison

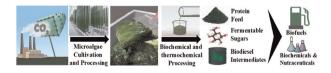
Francesco Ferlin, Giulia Brufani, Gabriele Rossini and Luigi Vaccaro*



7934

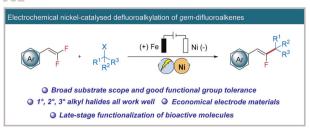
Potential of using microalgae to sequester carbon dioxide and processing to bioproducts

Venkatesh Balan,* James Pierson, Hasan Husain, Sandeep Kumar, Christopher Saffron and Vinod Kumar



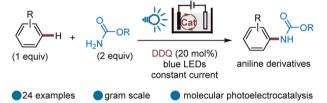
COMMUNICATIONS

7952



Electrochemical nickel-catalysed defluoroalkylation of gem-difluoroalkenes with alkyl halides

Yin Liu, Pengfei Li, Jun Tan, Guangsheng Kou, Dengke Ma* and Youai Qiu*



Photoelectrocatalytic C-H amination of arenes

Zhong-Wei Hou, Hong Yan, Jinshuai Song* and Hai-Chao Xu*

7963

TM-free reduction featuring iodide as the reducing catalyst and FA as the stoichiometric reductant, media and Brønsted activator

R, R': Alkyl (including Bn) and aryl w/ CN, C=O, Br, OMe substituents

Hydrogen-Bonding Formic Networks Enhance Brønsted Acid Activity

Introducing I⁻/formic acid as a green reagent for the reduction of sulfinates and sulfoxides

J. Armando Luján-Montelongo,* Luis Javier García de la Cuesta, Alicia É. Cruz-Jiménez, Perla Hernández and Alberto Vela

7971



Alkyl radicals from diacyl peroxides: metal-/base-/additive-free photocatalytic alkylation of N-heteroaromatics

Fukun Cheng, Lulu Fan,* Qiyan Lv, Xiaolan Chen* and Bing Yu*

COMMUNICATIONS

7978

CO₂ promoted photoredox/Ni-catalyzed semi-reduction of alkynes with H₂O

Shenhao Chen and Chanjuan Xi*

$$R^1 = R^2 + H_2O$$

$$CO_2$$

$$R^1 = R^2$$

$$R^2$$

$$R^2$$

$$R^2$$

$$R^2$$

$$R^2$$

$$R^2$$

$$R^2$$

$$R^2$$

$$R^2$$

$$R^3$$

$$R^2$$

$$R^3$$

$$R^2$$

$$R^3$$

$$R^4$$

$$R^2$$

$$R^3$$

- ▲ Mild conditions
- High stereoselectivity Z/E up to 99/1
- Broad substrate scope

PAPERS

7983

Photoinduced, additive- and photosensitizer-free multi-component synthesis of naphthoselenazol-2-amines with air in water

Hong-Tao Ji, Ke-Li Wang, Wen-Tao Ouyang, Qing-Xia Luo, Hong-Xia Li and Wei-Min He*

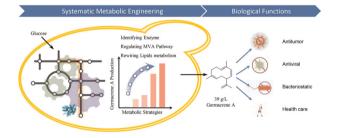
NC + Se +
$$R_1$$
 R_2 R_2 Blue LEDs H_2 O, alr, r.t. R_2 R_2 R_3 R_4 R_5 $R_$

Exogenous photosensitizer- and additive-free Visible light, water, air, room temperature, atom- & step-economy

7988

Reprogramming the metabolism of oleaginous yeast for sustainably biosynthesizing the anticarcinogen precursor germacrene A

Qi Liu, Ge Zhang, Liqiu Su, Pi Liu, Shiru Jia, Qinhong Wang and Zongjie Dai*



7998

Borylation of phenols using sulfuryl fluoride activation

Zhengjun Chen, Yan Liu, Chunhua Zeng, Changyue Ren, Hongyu Li, Rajenahally V. Jagadeesh,* Zeli Yuan* and Xinmin Li*

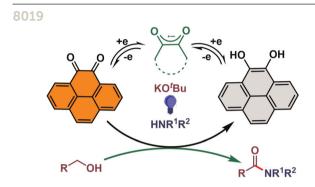


- One-pot synthesis Broad substrate scope
- Applicable to drugs, natural products, and fluorescent probes



Upcycling of plastic waste into carbon nanotubes as efficient battery additives

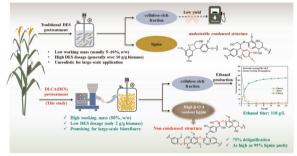
Eonu Nam, Gyori Park, Ji Young Nam, Sooryun Park, Yoonjeong Jo, Jihun Kim, Byung Gwan Park, Kyungeun Baek, Seok Ju Kang, Ho Won Ra, Youngsoo Park, Myung Won Seo,* Kyung Jin Lee* and Kwangjin An*



Organophotocatalytic dehydrogenative preparation of amides directly from alcohols

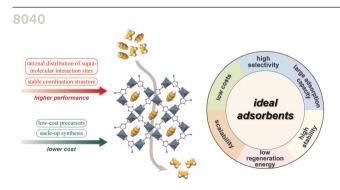
Shyamali Maji, Monojit Roy, Kanchan Shaikh and Debashis Adhikari*





Densification pretreatment with a limited deep eutectic solvent triggers high-efficiency fractionation and valorization of lignocellulose

Guannan Shen, Xinchuan Yuan, Yin Cheng, Sitong Chen, Zhaoxian Xu and Mingjie Jin*



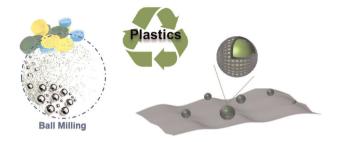
A scalable stable porous coordination polymer synthesized from low-cost precursors for efficient C₂H₂/C₂H₄ separation

Hengcong Huang, Yifan Gu, Luyao Wang, Tao Jia, Susumu Kitagawa and Fengting Li*

8047

Core-shell construction of metal@carbon by mechanochemically recycling plastic wastes: towards an efficient oxygen evolution reaction

Jiahua Zhao, Qiang Niu, Junjun Zhang* and Pengfei Zhang*



8057

Green and effective synthesis of multisubstituted α-pyrones via K₂CO₃ catalyzed formal insertion of ketenimines into C(CO)-C bonds of 1,3-diketones

Jian Luo, Ai-Qing Zhong, Jia-Hao Qiu, Xiong-Wei Liu,* You-Ping Tian, Bao-Hua Zhang,* Guo-Shu Chen, Wei Shu and Yun-Lin Liu*

Copper-catalyzed O-arylation of phenols with diazonium salts

Xin Fang, Chengning Qi, Xiangqian Cao, Zhi-Gang Ren, David James Young and Hong-Xi Li*

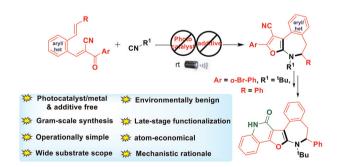
- Mild conditions
- Broad substrate scope
- Late stage modification

48 examples up to 93% yield

8074

Photocatalyst- and transition-metal-free syntheses of furan-fused dihydroazepines by visible light

Babasaheb Sopan Gore,* Chiao-Ying Kuo and Jeh-Jeng Wang*



8082

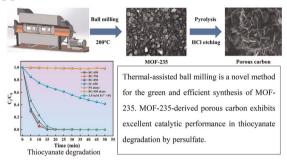


- Anionic polymerization in water
- ☑ Green cascade reaction
- ✓ Opened-system, mild conditions
- ☑ Commercial raw materials
- ☑ Without synthesis of episulfide
- ☑ Epoxide direct to polythioether

Green synthesis of well-defined linear poly(hydroxyl thioether) direct from epoxide in water

Ying Quan, Cuihong Ma, Qiancai Liu, Zhiying Han, Huijing Han, Xiaojuan Liao,* Ruyi Sun* and Meiran Xie*

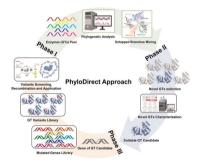
8093



Green and efficient synthesis of hierarchical porous carbon derived from MOF-235 for catalytic degradation of thiocyanate

Yang Yang, Binchuan Li, Daxue Fu, Jianshe Chen, Shuang Cui, Xiaocai He, Kuiren Liu, Shicheng Wei, Da Li and Qing Han*

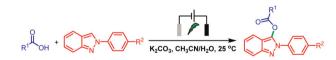
8108



A phylogeny-based directed evolution approach to boost the synthetic applications of glycosyltransferases

Peng Zhang, Yu Ji,* Shuaiqi Meng, Zhongyu Li, Dennis Hirtz, Lothar Elling and Ulrich Schwaneberg*

8117



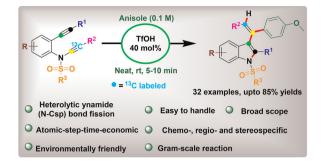
Electrochemical C3 acyloxylation reactions of 2H-indazoles with carboxylic acids via $C(sp^2)$ -O coupling

Xin Liu, Yibin Hu, Yuanbin She, Meichao Li* and Zhenlu Shen*

8124

Green and rapid acid-catalyzed ynamide skeletal rearrangement and stereospecific functionalization with anisole derivatives

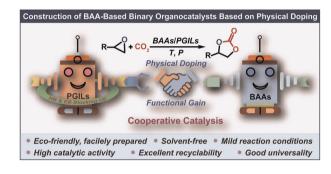
Mohana Reddy Mutra,* T. L. Chandana, Yun-Jou Wang and Jeh-Jeng Wang*



8134

Functionally enhanced basic amino acid-based binary organocatalysts based on physical doping for efficient coupling of CO₂ with epoxides

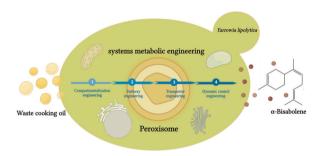
Fan Wang, Congxia Xie, Hongbing Song and Xin Jin*



8145

Biosynthesis of α -bisabolene from low-cost renewable feedstocks by peroxisome engineering and systems metabolic engineering of the yeast Yarrowia lipolytica

Baixiang Zhao, Yahui Zhang, Yaping Wang, Zhihui Lu, Lin Miao, Shuhui Wang, Zhuo Li, Xu Sun, Yuging Han, Sicheng He, Ziyuan Zhang, Dongguang Xiao, Cuiying Zhang,* Jee Loon Foo,* Adison Wong* and Aigun Yu*



8160

Efficient Fe₃O₄ nanoparticle catalysts for depolymerization of polyethylene terephthalate

Yoonjeong Jo, Eun Jeong Kim, Jueun Kim and Kwangjin An*

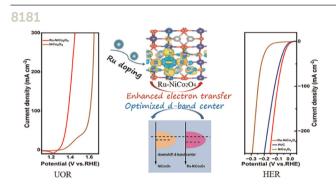


8172



Organoborane-catalysed reductive depolymerisation of catechyl lignin under ambient conditions

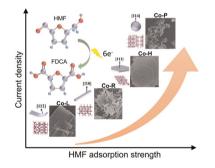
Shihao Su, Fan-shu Cao, Shuizhong Wang,* Qingru Shen, Gen Luo,* Qiang Lu and Guoyong Song*



Elaborately tailored NiCo2O4 for highly efficient overall water splitting and urea electrolysis

Yamei Wang, Lanli Chen, Huaming Zhang,* Muhammad Humayun, Junhong Duan, Xuefei Xu, Yanjun Fu, Mohamed Bououdina and Chundong Wang*

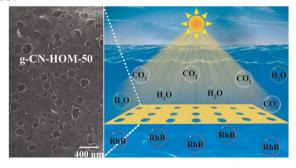
8196



Facet-dependent electrocatalytic oxidation activity of Co₃O₄ nanocrystals for 5-hydroxymethylfurfural

Zhenchuan Zhang, Zhaohui Yang, Chenyang Wei, Zhenghui Liu and Tiancheng Mu*

8207



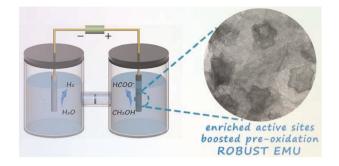
Controllable construction of graphitic carbon nitride with highly-ordered macropores for boosting photodegradation

Ruxia Li, Xiaoxiang Fan, Jianqi Meng, Jie Wu, Jinjuan Zhao, Ruifa Jin, Honglei Yang* and Shuwen Li*

8216

Tailoring the catalytically active sites in Co-based catalysts for electrochemical methanol upgrading to produce formate

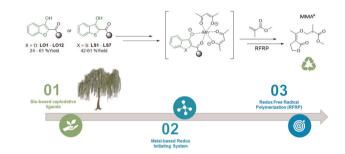
Yameng Wang, Xue Yang, Kexin Wang, Zimeng Liu, Xiaoning Sun, Jinyue Chen, Shanshan Liu, Xu Sun, Junfeng Xie* and Bo Tang*



8226

Bio-based captodative ligands for redox polymerization of Elium® thermoplastic composites under mild conditions

Nicolas Giacoletto, Marie Le Dot, Hizia Cherif, Fabrice Morlet-Savary, Bernadette Graff, Valérie Monnier, Didier Gigmes, Frédéric Dumur, Hamza Olleik, Marc Maresca, Pierre Gerard, Malek Nechab* and Jacques Lalevée*



8241

Feedstock agnostic upcycling of industrial mixed plastic from shredder residue pragmatically through a composite approach

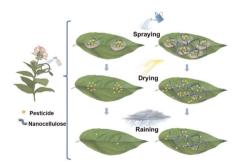
Kanjanawadee Singkronart, Andre Gaduan, Siti Rosminah Shamsuddin, Keeran Ward and Koon-Yang Lee*



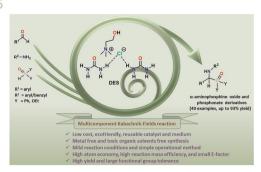
8253

Effectively enhancing topical delivery of agrochemicals onto plant leaves with nanocelluloses

Shangxu Jiang, Peng Li,* Li Li, Nasim Amiralian, Divya Rajah and Zhi Ping Xu*



8266



Synthesis of α -aminophosphorous derivatives using a deep eutectic solvent (DES) in a dual role

Susmita Mandal, Rajrani Narvariya, Shiva Lall Sunar, Ishita Paul, Archana Jain* and Tarun K. Panda*

8273

$$R^{1}$$
 R^{2} R^{3} R^{3

- · metal- and oxidant-free
- · mild and eco-friendly
- · high atom economy
- · broad substrate scope
- · construction of quaternary C

Electrochemical synthesis of γ -keto sulfones containing a β-quaternary carbon center via 1,2-migration

Wen Xia, Yawen Yang, Xiaohui Zhang, Liangzhen Hu* and Yan Xiong*

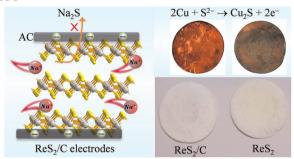
8280



Catalyst-free defluorinative alkylation of trifluoromethyls

Yan Huang, Yuan-Cui Wan, Yu Shao, Le-Wu Zhan, Bin-Dong Li* and Jing Hou*

8286



Carbon-coated ReS₂ hierarchical nanospheres to inhibit polysulfide dissolution in ether-based electrolytes for high-performance Na-ion batteries

Jun Xu,* Xuhui Zhang, Fang Cao, Zilin Mao, Junbao Jiang, Junwei Chen, Yan Zhang* and Kun Xing*