

Industrial Chemistry & Materials

An international journal of significant innovative research and major technological breakthroughs in all aspects of industrial chemistry and materials
rsc.li/icm

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 2755-2500 CODEN ICMNCZ 1(3) 273-466 (2023)



Cover
See Zhonghua Xiang *et al.*,
pp. 332–342.
Image reproduced by
permission of Zhonghua Xiang
from *Ind. Chem. Mater.*,
2023, 1, 332.

EDITORIAL

280

Introduction to the themed issue on frontiers of hydrogen energy and fuel cells

Lior Elbaz,* Minhua Shao,* Jianglan Shui* and Carlo Santoro*



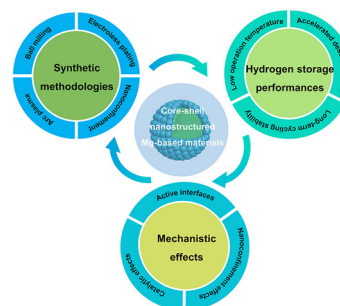
THEMED ISSUE ARTICLES

MINI REVIEWS

282

Core-shell nanostructured magnesium-based hydrogen storage materials: a critical review

Yinghui Li, Qiuyu Zhang, Li Ren, Zi Li, Xi Lin, Zhewen Ma, Haiyan Yang, Zhigang Hu and Jianxin Zou*



Editorial Staff

Managing Editor
Jing Kong

Assistant Editors
Huixian Dong, Xitong Wang

Content Development Editor
Yuwei Liang

Editorial Production Manager
Daniella Ferlucio

Regional Publisher
Guanqun Song

Publisher
Neil Hammond

Journals Launch Manager
Kathryn Gempf

For queries about submitted papers, please contact Sarah Whitbread Editorial Production Manager, in the first instance. E-mail: icmprod@rsc.org

For pre-submission queries, please contact Jing Kong, Managing Editor
Email: icm@rsc.org

ICM (Print ISSN 2755-2608; Online ISSN 2755-2500) is published 4 times a year by the Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, CB4 0WF, UK.

ICM is a Gold Open Access journal and all articles are free to read

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

Industrial Chemistry & Materials

rsc.li/icm

Industrial Chemistry & Materials (ICM) publishes significant innovative research and majortechnological breakthroughs in all aspects of industrial chemistry and materials, with a particular focus on the important innovation of low-carbon chemical industry, energy and functional materials.

Editor-in-Chief

Suojiang Zhang, Institute of Process Engineering, CAS, China / Henan University, China

Associate Editor

Maozhong Fan, University of Wyoming, USA
Chao Lu, Zhengzhou University/Beijing University of Chemical Technology, China
Anja V. Mudring, Aarhus University, Denmark

Rong Sun, Shenzhen Institute of Advanced Electronic Materials, CAS, China
Quanhong Yang, Tianjin University, China
Shouliang Yi, National Energy Technology Laboratory, USA

Tierui Zhang, Technical Institute of Physics and Chemistry, CAS, China
Xiangping Zhang, Institute of Process Engineering, CAS, China

Advisory board

Matthias Beller, LIKAT Rostock, Germany
Xianhe Bu, Nankai University, China
Yu Fang, Shaanxi Normal University, China
Jerzy Leszczynski, Jackson State University, USA

Qilong Ren, Zhejiang University, China
Blake A. Simmons, Lawrence Berkeley National Laboratory, USA
Chunming Xu, China University of Petroleum, China

Donghui Zhang, Dalian Institute of Chemical Physics, CAS, China

Editorial board members

Santiago Aparicio, University of Burgos, Spain
Hongbin Cao, Institute of Process Engineering, CAS, China
George Zheng Chen, University of Nottingham, UK
Liwei Chen, Shanghai Jiao Tong University, China
Weihua Chen, Zhengzhou University, China
Walid Daoud, City University of Hong Kong, China
Shoubhik Das, University of Antwerp, Belgium
Xianfeng Fan, University of Edinburgh, UK
Mara G. Freire, University of Aveiro, Portugal
Feng Gao, Linköping University, Sweden
Yanlong Gu, Huazhong University of Science and Technology, China
Ruilan Guo, University of Notre Dame, USA
Yu Han, King Abdullah University of Science and Technology, Saudi Arabia
Niklas Hedin, Stockholm University, Sweden
Peter Hesemann, University of Montpellier, France
John D. Holbrey, Queen's University Belfast, UK
Xu Hou, Xiamen University, China
Yongsheng Hu, Institute of Physics, CAS, China

Anker Degn Jensen, Technical University of Denmark, Denmark
Xiaoyan Ji, Lulea University of Technology, Sweden
Arjan W. Kleij, Institute of Chemical Research of Catalonia, Spain
Changzhi Li, Zhejiang University, China
Xianfeng Li, Dalian Institute of Chemical Physics, CAS, China
Yingwei Li, South China University of Technology, China
Di-jia Liu, Argonne National Laboratory, USA
Jianmei Lu, Soochow University, China
Xiang Ma, East China University of Science and Technology, China
Anton Middelberg, The University of Adelaide, Australia
Kotohiro Nomura, Tokyo Metropolitan University, Japan
Lijia Pan, Nanjing University, China
Srikanth Pilla, Clemson University, USA
Albert Poater, University of Girona, Spain
Jieshan Qiu, Beijing University of Chemical Technology, China
Mark B. Shiflett, University of Kansas, USA
Weiqun Shi, Institute of High Energy Physics, CAS, China
Seema Singh, Joint BioEnergy Institute, USA
Zhi Sun, Institute of Process Engineering,

CAS, China
Atsushi Urakawa, Delft University of Technology, Netherlands
Xiangjian Wan, Nankai University, China
Guoxiu Wang, University of Technology Sydney, Australia
Jianguo Wang, Zhejiang University of Technology, China
Yapei Wang, Renmin University of China, China
Yuen Wu, University of Science and Technology of China, China
Qun Xu, Zhengzhou University, China
Yijun Xu, Fuzhou University, China
Feng Yan, Soochow University, China
Chunxia Zhao, The University of Adelaide, Australia
Huijun Zhao, Griffith University, Australia
Haitao Zhang, Institute of Process Engineering, CAS, China
Xin Zhang, Institute of Process Engineering, CAS, China
Ying Zhang, University of Science and Technology of China, China
Gengfeng Zheng, Fudan University, China
Ying Zheng, Western University, Canada

Information for Authors

Full details on how to submit material for publication in ICM are given in the Instructions for Authors (available from <https://www.rsc.org/journals-books-databases/about-journals/industrial-chemistry-materials>). Submissions should be made via the journal's homepage: rsc.li/icm

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 owned by the © Institute of Process Engineering, Chinese Academy of Sciences, China 2022.

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.

∞ The paper used in this publication meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).
Registered charity number: 207890

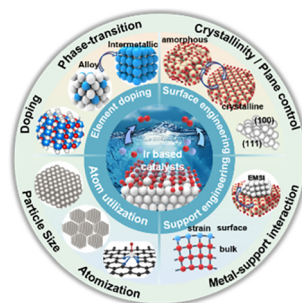


MINI REVIEWS

299

Designing active and stable Ir-based catalysts for the acidic oxygen evolution reaction

Zijie Lin, Tanyuan Wang* and Qing Li*

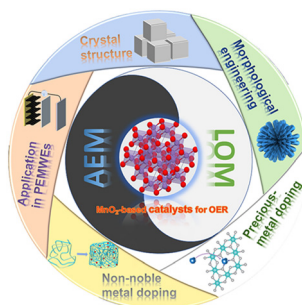


REVIEW

312

Recent progress of manganese dioxide based electrocatalysts for the oxygen evolution reaction

Yunlong He, Zhenye Kang,* Jing Li, Yawei Li* and Xinlong Tian*

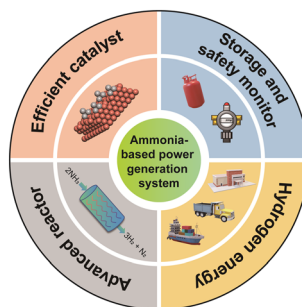


PERSPECTIVE

332

Ammonia as a carbon-free hydrogen carrier for fuel cells: a perspective

Lingling Zhai, Shizhen Liu and Zhonghua Xiang*

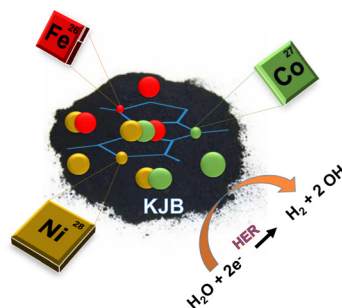


PAPERS

343

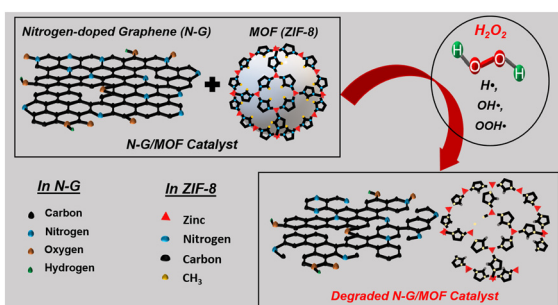
Mono-, bi- and tri-metallic platinum group metal-free electrocatalysts for hydrogen evolution reaction following a facile synthetic route

Seyed Ariana Mirshokraee, Mohsin Muhyuddin, Jacopo Orsilli, Enrico Berretti, Laura Capozzoli, Alessandro Lavacchi, Carmelo Lo Vecchio, Vincenzo Baglio, Anna Galli, Andrea Zaffora, Francesco Di Franco, Monica Santamaria, Luca Olivi, Simone Pollastri and Carlo Santoro*



PAPERS

360



Investigation on electrocatalytic performance and material degradation of an N-doped graphene-MOF nanocatalyst in emulated electrochemical environments

Niladri Talukder, Yudong Wang, Bharath Babu Nunna, Xiao Tong, Jorge Anibal Boscoboinik and Eon Soo Lee*

REGULAR RESEARCH ARTICLES

MINI REVIEW

376

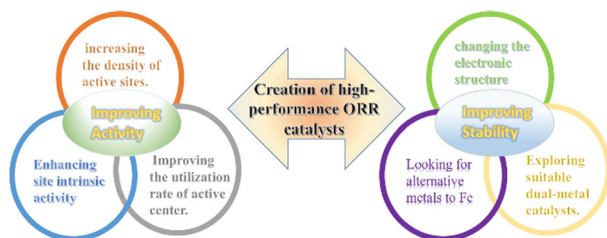


Hierarchically microporous membranes for highly energy-efficient gas separations

Shuangjiang Luo, Tianliang Han, Can Wang, Ying Sun, Hongjun Zhang, Ruilan Guo* and Suojing Zhang*

REVIEWS

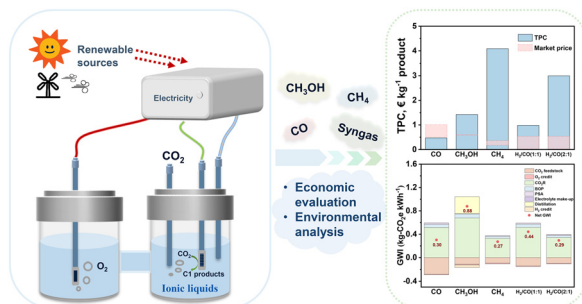
388



Non-noble metals as activity sites for ORR catalysts in proton exchange membrane fuel cells (PEMFCs)

Jinjing Tao, Xian Wang,* Mingjun Xu, Changpeng Liu, Junjie Ge* and Wei Xing*

410



Electrochemical CO₂ reduction with ionic liquids: review and evaluation

Yangshuo Li, Fangfang Li, Aatto Laaksonen, Chuan Wang, Paul Cobden, Per Boden, Yanrong Liu, Xiangping Zhang and Xiaoyan Ji*

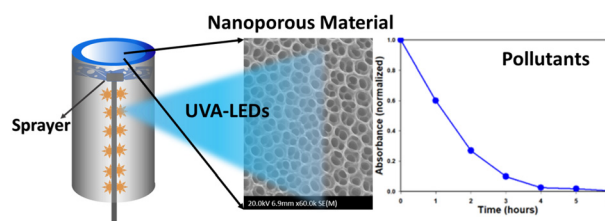


PAPERS

431

A highly efficient photocatalytic system for environmental applications based on TiO₂ nanomaterials

Sapanbir S. Thind, Mathias Paul, John B. Hayden, Anuj Joshi, David Goodlett and J. Scott McIndoe*



443

Tunable construction of CuS nanosheets@flower-like ZnCo-layered double hydroxide nanostructures for hybrid supercapacitors

Akbar Mohammadi Zardkhoshoui,* Ramtin Arian and Saied Saeed Hosseiny Davarani*



458

Polyaniline-derived carbon nanofibers with a high graphitization degree loading ordered PtNi intermetallic nanoparticles for oxygen reduction reaction

Yujuan Zhuang, Jiao Yang, Lingwei Meng, Chuanming Ma, Lishan Peng,* De Chen* and Qingjun Chen*

