

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*



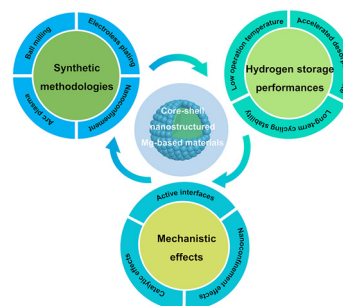
THEMED ISSUE ARTICLES

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 Ferluccio

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 major technological 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

Maohong 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 Hessemann, 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

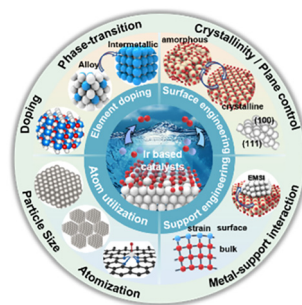


MINI REVIEWS

299

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

Zijie Lin, Tanyuan Wang* and Qing Li*

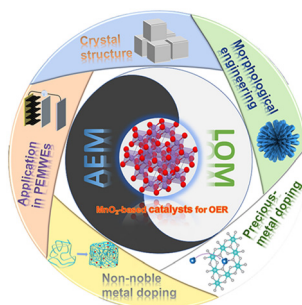


REVIEW

312

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

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

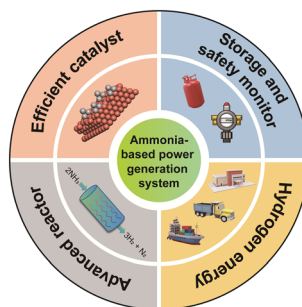


PERSPECTIVE

332

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

Lingling Zhai, Shizhen Liu and Zhonghua Xiang*

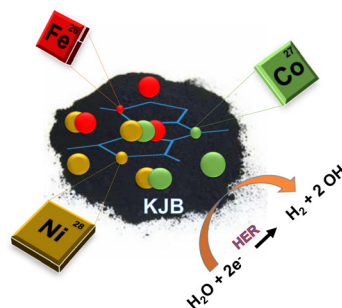


PAPERS

343

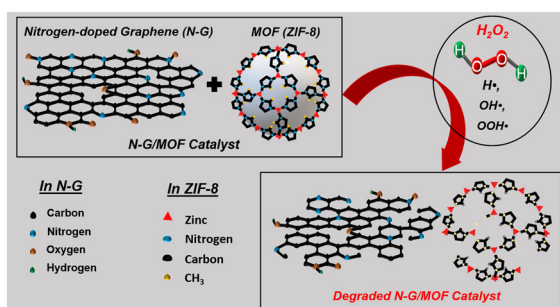
Mono-, bi- and tri-metallic platinum group metal-free electrocatalysts for hydrogen evolution reaction following a facile synthetic route

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

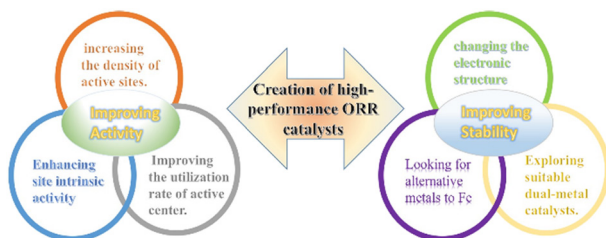


Hierarchically microporous membranes for highly energy-efficient gas separations

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

REVIEWS

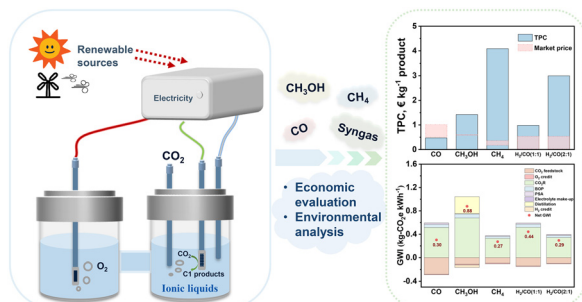
388



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*

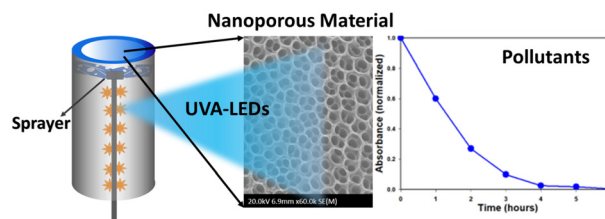


PAPERS

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*

