Industrial Chemistry & Materials

EDITORIAL

Check for updates

Cite this: Ind. Chem. Mater., 2023, 1, 280

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

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

DOI: 10.1039/d3im90010j

rsc.li/icm

Climate change calls for a change in the way we use and produce energy, and carbon-free has become the future direction of energy production and utilization. To obtain this, we must rely on sustainable energy sources such as wind and sun, but their intermittence limits the production of clean energy to only a few hours a day. To overcome issue, energy storage this and production technologies must be developed. Although several technologies have been proposed, the only viable scheme that could allow short-to-long-term storage and efficient

energy transportation at-scale is the hydrogen economy, which relies on three pillars of technology: electrolyzers, hydrogen storage and fuel cells. In recent years, there have been rapid technological advances in hydrogen production, new hydrogen storage high-performance materials, and hydrogen fuel cells, etc. However, there still numerous technological are difficulties to overcome in each of these segments before hydrogen energy can be applied on a large scale. The current themed issue on hydrogen energy and fuel cells, addresses these difficulties

and gives a comprehensive and highlevel outlook to the studies conducted nowadays in these areas and some of interesting results the most and prospects.

As the first journal from the cooperation between the Royal Society of Chemistry and the Institute of Process Engineering of the Chinese Academy of Sciences, Industrial Chemistry & Materials has always been committed to promoting the green revolution and innovation of the chemical industry and materials manufacturing from theory to practice. This themed issue focuses on

(2003), MSc (2005) and PhD (2009) from the **Ben-Gurion** University, Israel. development of

fuel cells, and advanced electrochemical methods. He is the head of the Israeli Fuel Cells Consortium, a representative in the International Energy Agency's Advanced Fuel Cells Executive Committee, a member of the Israeli Presidential Climate Forum, and the Director of the Hydrogen Technologies Labs (H2Tech) at Bar-Ilan University. He is the co-founder of two Israeli start-up companies, and the author of more than 70 peer-reviewed articles.

He then worked as a postdoc at Los Alamos National Lab, US (2009-2013), he is currently an associate professor at Bar-Ilan University, Israel. His work focuses on the development of advanced PGM-free catalysts for fuel cells and electrolyzers, the hydrogen carriers, direct hydrogen carrier

Lior Elbaz received his BSc



Minhua Shao is a Cheong Ying energy Chan Professor of engineering and environment, chair professor in the Department of Chemical and Biological Engineering at the Hong Kong University of Science and Technology (HKUST). He is also the Director of the HKUST Energy Institute. He is an Associate Editor for the Journal of the Electrochemical Society. He has published over 240 peerreviewed articles, 1 book and has

filed over 30 patent applications (19 issued). He has also received a number of awards, including the International Outstanding Young Chemical Engineer Award (2022) and the Supramaniam Srinivasan Young Investigator Award from the ECS Energy Technology Division (2014). He is one of the founding members of the Young Academy of Science of Hong Kong and a fellow of the Electrochemical Society.

Lior Elbaz



View Article Online

View Article Online

the development of advanced catalysts for the reactions that occur in fuel cells: the oxygen reduction reaction (ORR) and the hydrogen oxidation reaction, and showcases the work on advanced Ptgroup metal-free (PGM-free) catalysts that are essential to replace PGMs in fuel cells because of their lower price. This is a very challenging task, since the current PGM-free ORR catalysts are considered inferior in performance when compared with catalysts with PGMs, especially in proton exchange membrane fuel cells. However, PGM-free catalysts do seem to be more suited for anion exchange membrane fuel cells, which have been making a significant leap in performance in durability in recent years, mainly due to improved polymer chemistry which allowed the use of advanced membrane and polyelectrolytes. Electrolyzers face a similar problem, mainly related to performance and durability. The lack of agreed-upon durability protocols hinders the focused progress in the field, but most recent results on PEM and AEM electrolyzers are also very promising. The third topic covered in this themed issue is hydrogen storage, addressed here in the use of chemical hydrogen carriers such as ammonia. These studies are at the forefront of the effort for realizing the full potential of the hydrogen economy, and hopefully will pave the way for a cleaner future.

As guest editors, we would like to thank the Editor-in-Chief, Suojiang Zhang, for the opportunity to support the production of this important themed issue, thank all and we contributing authors for their outstanding submissions, and give a special thanks to the associate editors, reviewers, and editorial office staff, for their efforts to make this wonderful themed issue come true.

Lior Elbaz: lior.elbaz@biu.ac.il Minhua Shao: kemshao@ust.hk Jianglan Shui: shuijianglan@buaa.edu.cn Carlo Santoro: carlo.santoro@unimib.it

Carlo Santoro got his PhD at the

University of Connecticut in

2009, working on microbial fuel

cells. He moved to the University

of New Mexico in 2013 working

on platinum-free electrocatalysts

for oxygen reduction reaction

supercapacitive

Following a spell as a lecturer at

the University of Manchester

(2020), he joined the University

of Milano-Bicocca in 2021 as an

assistant professor, where he

bio-

systems.



Jianglan Shui

electrocatalysts, PEM fuel cell and hydrogen storage materials. To date, he has published more than 100 papers, including in Science, Nature Nanotechnology and Nature Catalysis.

Jianglan

and

University.

research

Case

Shui

Bachelor degree from Tianjing

University in 2000, his PhD from

the University of Science and

Technology of China (2006), and

a second PhD from the University

of Rochester (2010). From 2010-

2014, Shui worked as a postdoc

at Argonne National Laboratory

Не

professor at Beihang University,

Beijing, China in 2015. His

focuses

received

Western Reserve

became

his

а

on



Carlo Santoro

established the Electrocatalysis and Bioelectrocatalysis Lab (EBLab). His work focuses on the development of electrocatalysts based on platinum-group metal-free materials for electrochemical systems, pursuing biomimetic and bioinspired approaches. He has published over 120 manuscripts and holds 2 patents.

and

electrochemical