Preface for Special Section on Fuel Cell Technology

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Accepted: 7 April 2021 / Published online: 8 May 2021
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Faced with the resource shortage and environmental problems, the development and utilization of new energy are deemed critical in many countries around the world in order to adapt to the change of energy supply and demand pattern as well as ensure national energy security. As a system that converts chemical energy of fuel oxidation directly into electric energy, fuel cell has shown strong competitiveness in the field of transportation, and is regarded as a new generation of vehicle power source and is favoured by the world, because of its advantages such as high efficiency, environment-friendly, long driving range, high reliability, no vibration and noise, efficiency changing with the output power, strong overload capacity and so on.

Fuel cell technology development has gradually become a research hotspot in the global energy field. A large number of investigations have been carried out on the preparation technology and basic theory of key materials, components and system such as high activity and anti-aggregation electrocatalyst, high specific surface area and anti-oxidation support, high conductivity and self-humidifying electrolyte, high permeability and high stability carbon paper, anti-corrosion and high conductivity bipolar plates, high performance membrane electrode assembly and fuel cell power system. However, fuel cells are still facing a series of challenges, such as high cost, insufficient material performance, electrode design and thermal management technology to be improved, requiring the joint efforts of researchers worldwide to contribute to fuel cells into the practical application as soon as possible.

In this special section, we have gathered 5 papers with significant contributions in the field of fuel cell, which reflects the latest advances in developing and understanding the design and optimization of key materials and components of fuel cells. The papers, as listed below, cover the topics of carbon support evaluation, Pt-free cathode electrocatalyst, cathode catalyst layer design, local behaviours

characterization of fuel cell and heat exchanger numerical analysis.

The paper No. 1 “Modifying carbon supports of catalyst for the oxygen reduction reaction in vehicular PEMFCs” provides an efficient method to evaluate PEMFC carbon supports for vehicles. It is helpful to select a suitable carbon support to achieve uniform dispersion of Pt nanoparticles, resist corrosion and reinforce metal-support interactions, which is beneficial to improve the overall fuel cell performance.

The paper No. 2 “Proton exchange membrane (PEM) fuel cells with platinum group metal (PGM)-free cathode” reviews the research progress of PGM-free fuel cell cathode catalysts in recent years, summarizes the main challenges and puts forward the promising strategies to address the challenges. This work is helpful for readers to have a quick and comprehensive understanding of PGM-free cathode catalysts.

The paper No. 3 “Cathode design for proton exchange membrane fuel cells in automotive applications” reviews the effects of cathode design on performance of PEMFCs, presents the measurement to achieve higher power density for automotive application and provides a good reference for readers in this field.

The paper No. 4 “Experimental investigation on local behaviors of PEMFC with segmented cell” investigates on local behaviors of PEMFC with segmented cell, puts forward novel research methods to directly test the internal local RH, current and temperature to analyse co-flow and counter-flow effects of air/H₂ and draws a conclusion with great application value.

The paper No. 5 “Air-side fin geometry of tube-strip heat exchanger for fuel cell vehicles” constructs the typical unit cell of tube-strip heat exchanger to obtain the cell-level thermal performance of heat exchanger for fuel cell vehicles numerically. It provides valuable theoretical support for the design of heat management of fuel cell vehicle systems.

The publication of this special issue would not be achieved without the meticulous work and joint efforts of all the authors, reviewers and editors. We would like to thank all authors, reviewers and the staff from the editorial office of *Automotive Innovation* for their hard work and support.

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Heartly hope this special issue can inspire scientific ideas and promote researches in the fields of fuel cell.

Guest Editors

Prof. Cunman Zhang, Professor in the School of Automotive Studies, the Deputy Director of Clean Energy Automotive Engineering Center and the Director of Institute of Fuel Cell Hybrid Power, Tongji University. His current research interests is hydrogen energy and fuel cell technology, including electrolytic hydrogen production

technology from renewable energy, high pressure hydrogen storage technology and safety on vehicle, key technology of hydrogen refuelling station and hydrogen safety evaluation system, core technology of high performance and high power fuel cell stack and so on. In recent years, he has published more than 80 high-level academic papers and has been granted over 40 invention patents.

Prof. Shangfeng Du, Associate Professor in Chemical Engineering, leading Low Temperature Fuel Cell and Electrolyser research group at the University of Birmingham. He is a recipient of Marie Curie Incoming International Fellowship and Science City Fellowship. His group is focused on electro-

chemical engineering research of catalyst electrodes that bridges the gap between the novel catalyst nanostructures and high power performance devices. His research activities cover electrode design, 1D nanostructure development, surface and interface characterization for fuel cells, electrolyzers and zinc-air batteries. Research is also carried on the characterization of adhesion and aggregation of nanoparticles for health and energy applications.

Prof. Shuhui Sun, Full Professor at the Institut National de la Recherche Scientifique (INRS), center for Energy, Materials, and Telecommunications (Montreal, Canada), where he directs the Laboratory of Sustainable Nanotechnology. He is a member of the Royal Society of Canada's College of New Scholars, and is among the

world's top 2% scientists. His current research interests focus

on multi-functional Nanomaterials for Energy Conversion and Storage, including H₂ fuel cells (low-Pt and Pt-free catalysts), Lithium batteries, Zn-air batteries, Na-ion/Zn-ion batteries, CO₂ reduction, water splitting for hydrogen generation, as well as wastewater treatment. He has published over 220 articles in peer-reviewed journals, and his publications have been cited over 12,000 times with an H index of 56. He has edited 3 books, published 14 book chapters and holds 2 US patents.

Prof. Hao Tang, Distinguished Professor, Director of Hydrogen and Fuel Cell Research Institute at University of Electronic Science and Technology of China. Dr. Tang has over 26 years of industrial and academic experience in the fundamental research, engineering design and product development in the field of hydrogen and fuel cell. Under

his leadership, his R&D team has developed a series of commercial products including the key components of fuel cell, hydrogen power systems, and testing equipment. Dr. Tang has co-authored more than 50 research papers published in referenced journals and holds over 70 national and international patents.

Prof. Junliang Zhang, Zhiyuan Chair Professor, Director of Institute of Fuel Cells, Executive Dean of Zhiyuan College at Shanghai Jiao Tong University (SJTU). From 2007 to 2011, Dr. Zhang worked at General Motors Global Research and Development, Electrochemical Energy Research Laboratory in New York, as

a Research Scientist and later a Senior Scientist and Team Leader, responsible for the development of automotive fuel cells. In 2011, he joined the Institute of Fuel Cells at SJTU. Dr. Junliang Zhang's key expertise is in electrochemistry, electrocatalysis and fuel cells. He has published over 120 peer-reviewed journal articles on electrochemical energy conversion and storage, which have been cited for more than 10,000 times so far. He authored two book, two book chapter and co-invented 50 plus patents.