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{DEPARTMENT OF CHEMISTRY}

Expert Lecture

Rational Design of Novel Nanomaterials for Fuel Cells and Batteries

By

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As clean and sustainable energy conversion devices, H_2 fuel cells are expected to play a dominant role in future clean energy solutions for various applications, particularly for electric vehicles (EVs). However, the high cost of Pt catalyst is one of the main obstacles to the wide-spread commercialization of H_2 fuel cells. Therefore, developing highly efficient low-Pt and non-platinum-group metal (Non-PGM) catalysts is one of the key solutions to solve the above-mentioned challenges. On the other hand, rechargeable aqueous zinc-ion batteries (ZIBs) and rechargeable zinc-air batteries (ZABs) have been considered as highly promising alternatives for the next-generation energy storage technologies due to their advantages of high energy density, low cost, high safety, and environmental friendliness. The development of high-performance cathode materials for ZIBs and highly efficient bifunctional ORR/OER electrocatalysts for ZABs is highly desirable, however, remains a grand challenge.

First, I will present our recent progress in developing advanced electrocatalysts mainly for oxygen reduction reaction (ORR) in H_2 fuel cells. Among the Non-PGM catalysts, Fe/N/C catalysts are considered one of the most promising ORR catalysts. Major breakthroughs have been made by INRS (2009 *Science*, 2011 *Nature Communications*), with activity and performance of Fe/N/C catalyst approaching that of Pt. However, the durability of Fe/N/C catalysts is still insufficient for practical applications and its performance decay mechanism is still unclear. Very recently, we made a systematic study to verify whether iron is at the origin of the first rapid decay (stability problem) of the Fe/N/C catalyst for ORR in PEMFCs, which is important to find better ways to improve the durability of Fe/N/C catalysts. Moreover, other types of novel nanostructured Non-PGM catalysts will also be discussed. At the same time, a series of low-Pt nanostructured electrocatalysts, synthesized by green chemistry and atomic layer deposition (ALD), including nanowires, nanotubes and single atoms, for fuel cells will also be presented. In the end, I will also introduce our work beyond fuel cells, including Li-ion/Na-ion/Zn-ion batteries, water splitting for H_2 production, metal-air batteries, and water treatment.

Biography

Dr. Shuhui Sun is a Full Professor at the Institut National de la Recherche Scientifique, center for Energy, Materials, and Telecommunications (INRS-EMT) in Montreal, Canada, where he directs the Laboratory of Sustainable Nanotechnology (SUN). His current research interests focus on the development of multi-functional nanomaterials (graphene, CNTs, MOF, metal and metal oxides) for Energy Conversion and Storage, and Environmental applications, including fuel cells (low-Pt and Pt-free catalysts), Li-ion/Na-ion/Zn-ion batteries, Zn-air batteries, Water splitting for hydrogen generation, as well as Wastewater treatment. He has edited 3 books, 15 book chapters, and published over 210 peer-reviewed articles, including over 80 articles in journals with IF>10, such as *Nature Communications*, *Energy & Environmental Science*, *Advanced Materials*, *J. Am. Chem. Soc.*, *Advanced Energy Materials*, *Adv. Funct. Mater.*, *Materials Today*, *Angew. Chem. Int. Ed.*, *Nano Energy*, *Energy Storage Materials*, *ACS Nano*, *Applied Catalysis B*, etc. He also holds 2 US patents. His publications have been cited over 11,500 times with an H-index of 55.

Prof. Sun is the recipient of various awards, such as Member of the Royal Society of Canada's of the College of New Scholars (2020), Canadian Catalysis Lectureship Award (2020), the member of Global Young Academy (2017), ECS-Toyota Young Investigator Fellow (2017), UPAC Novel Materials Youth Prize (2017), Canada Governor General's Academic Gold Medal, NSERC Alexander Graham Bell Canada fellowship, ISE award for young electrochemist, etc. He is a member of ISE, ECS, CSC, CQMF, Plasma Quebec, Sigma Xi, and UNESCO Chair for Materials and Technology for Energy Conversion, Saving and Storage (MATECSS). He is the Vice President of the International Academy of Electrochemical Energy Science (IAOEEs). He serves as the Executive Editor-in-Chief of *Electrochemical Energy Reviews* (EER), editor/editorial board of 8 journals related to nanomaterials and energy.



Date and Time:

April 27th, 2022 (Wednesday)

5:00 PM (Online)

Google Meet Link: <https://meet.google.com/rbv-sbpf-hop>