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Strategies to Improve the Stability of Fe/N/C Catalysts in PEM Fuel Cells

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Abstract:

Proton-exchange membrane (PEM) fuel cells hold promising applications in transportation and stationary, however, their widespread commercialization is greatly hindered by the high cost. Platinum (Pt) represents one of the largest cost components of a fuel cell, therefore, many R&D activities have been focusing on strategies that will increase the activity and utilization of platinum group metal (PGM) catalysts, and PGM-free catalysts for long-term applications. In this talk, I will first briefly present our work on developing low-Pt catalysts (various unique nanostructured Pt nanowires, nanotubes, alloys and single atoms) to significantly increase the activity and stability of the Pt-based catalysts for ORR in fuel cells. Then, I will mainly focus on our work on Fe/N/C catalysts. Based on the major breakthroughs on Fe/N/C catalyst achieved by the Dodelet team at INRS (with the MEA activity and performance approaching that of Pt catalyst) [Science 2009, Nature Commun 2011], in collaboration with Ballard Power Systems and Toyota, we have made important progress on improving the stability of Fe/N/C catalyst. Specifically in the following aspects: (i) identifying the active sites, (ii) understanding the fuel cell degradation mechanisms experimentally and theoretically, (iii) developing approaches to improving the stability of the Fe/N/C catalyst, such as pore size control, and fluorination, and (iv) catalyst layer and electrode optimization, such as catalyst hydrophobicity adjustment, Fe/N/C and ultra-low loading Pt/C hybrid catalyst.

Bio: Dr. Shuhui Sun is a Full Professor at the Institut National de la Recherche Scientifique (INRS), center for Energy, Materials, and Telecommunications (Montreal, Canada). Dr. Sun is a Fellow of the Canadian Academy of Engineering (CAE), a member of the Royal Society of Canada (College), the Vice President of the International Academy of Electrochemical Energy Science (IAOEES), and the Executive Editor-in-Chief of *Electrochemical Energy Reviews* (Springer-Nature, IF=32.8). He is among the world's top 2% scientists (career-long impact). Dr. Sun's research interests focus on developing functional materials for energy conversion and storage, including hydrogen fuel cells (low-Pt and Pt-free catalysts, ionomers), hydrogen generation, lithium batteries, and metal-air batteries. He has published over 260 peer-reviewed journal articles (e.g., Nature Communications, Science Advances, Energy & Environmental Science, Advanced Materials, Advanced Energy Materials, J. Am. Chem. Soc., Angew. Chem, etc), with citations of over 16,800 times and an H index of 70. He has edited 3 books and published 15 book chapters. His recent awards include the Research Award (2021) from the International Association for Hydrogen Energy (Fuel cell division), the Canadian Catalysis Lectureship Award (2020), ECS-Toyota Young Investigator Fellow (2017), etc