ChE SEMINAR

Experimental Characterization, Reconstruction and Pore Scale Modelling of Fuel Cell Catalyst Layers

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ABSTRACT

The catalyst layer is a central component of polymer electrolyte membrane fuel cells. This thin (~10μm) nanostructured porous layer is the site of an array of coupled transport processes, including flow of reactants, product water, heat and charged species and reaction kinetics. The effectiveness of these transport processes is critical to performance and durability, yet their characterization has been limited by fundamental experimental and modelling challenges.

Progress made in predicting the effective transport properties of PEM fuel cell catalyst layers from first principles will be presented. The methodology relies on (i) experimental characterization using advanced microscopy (FIB/SEM); (ii) numerical reconstruction of the morphology; and (iii)) pore scale modelling. Sample results will be presented, and challenges and prospects related to FIB/SEM tomography characterization, reconstruction algorithms and modelling issues such as Knudsen diffusion will be discussed.

ABOUT THE SPEAKER



Ned Djilali is Professor of Mechanical Engineering at the University of Victoria, where he holds the Canada Research Chair in Advanced Energy Systems. His research focuses on transport phenomena (fluid flow, heat, mass and charge transport) and energy systems integration and analysis. The applications of this research have ranged from aerodynamics and turbulence, to electrochemical energy conversion and water purification. Prior to joining UVic, he was staff specialist with the Advanced Aerodynamics Department at Bombardier Inc, where he worked on the design of the Regional Jet.

His current research focuses on fuel cells and hydrogen systems, integration of renewable energy systems in smart grids, and transport phenomena in porous materials. Professor Djilali has published over 140 journal papers, holds several patents, and has collaborated with leading automotive and clean energy technology companies and organizations around the world. He has served as Director of both UVic's Institute for Integrated Energy Systems and the Pacific Institute for Climate Solutions, leading and facilitating the development and implementation of low carbon energy systems. Professor Djilali was elected Fellow of the Canadian Academy of Engineering in 2010 and Fellow of the Royal Society of Canada in 2013.