Washington University in St. Louis
School of Engineering & Applied Science

Energy, Environmental & Chemical Engineering

EECE Department Seminar

Friday, March 3, 2017

11:00am

Brauer Hall, Room 12

Transport Processes in Energy Conversion and Storage Devices: X-ray Computed Tomography Study

ABSTRACT

Understanding transport processes in thin porous carbon materials is critical for electrochemical energy applications. However, tools that are designed for characterization of porous media on a large scale are not always applicable for thin (< 500 um) layers. Moreover, it is essential to bridge nano- and micro-scale transport processes, as fine nano-structures of carbon materials are desirable for high surface area and the features of a larger size are needed for high hydraulic permeation. To characterize transport on nano and micro-scales synchrotron X-ray computed tomography (CT) is well-fit due to its fast, non-intrusive measurements that allows quantification of morphological properties of porous media.

For polymer-electrolyte fuel cells (PEFCs) and anion exchange membrane fuel cells (AEMFCs) effective water management remains a hurdle, especially at lower operating temperatures. During start-up and operation liquid water formed as a byproduct of electrochemical reaction can block gas (reactant) delivery to a catalyst, resulting in flooding, mass-transport losses, and low cell power densities. Using synchrotron X-ray CT we have previously shown morphology and transport dependencies on material structure, compression and chemical composition. These *ex-* and *in-situ* studies are useful and shed light on an isolated transport phenomena. Continuum, pore-network and direct meshing models are used to explain the observed phenomena and to guide the fuel cells components design. Addressing and understanding water transport issues, however, is made possible by introducing the capabilities for *in-operando* X-ray CT. This presentation focuses on *in-operando* techniques for understanding water management in PEFCs and AEMFCs and examples of various operating conditions will be presented.

Iryna Zenyuk, Professor

Department of Mechanical Engineering, Tufts University

Professor Iryna Zenyuk holds a B.S. (2008) in mechanical engineering from the New York University Tandon School of Engineering. She continued her studies at Carnegie Mellon University, where she earned M.S. (2011) and Ph.D. (2013). Her graduate work focused on fundamental understanding of meso-scale interfacial transport phenomena and electric double layers in electrochemical energy-conversion systems. After a postdoctoral fellowship at Lawrence Berkeley National Laboratory in Electrochemical Technologies Group with Dr. Adam Z. Weber Prof. Zenyuk joined the faculty of the Mechanical Engineering Department at Tufts University in 2015.

At Tufts, Prof. Zenyuk is the director of SEELab (Sustainable Electrochemical Energy Lab). With the recent technological advances in the transportation sector, robotics and implantable electronics, there is a growing need for reliable, lightweight and durable energy sources to power these technologies. Prof. Zenyuk's group works on enabling energy solutions by researching high power-density low-temperature hydrogen fuel-cells, Li-metal batteries and electrolyzers. Currently fuel cells durability, low-temperature operation, cost and water flooding are still issues that need to be solved. Prof. Zenyuk works on addressing the problems of the existing state-of-the-art fuel cells through a design

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