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221 MEC
1:00 to 2:25pm

"Fuel Cells: Systems, Characterizations and Materials"

Abstract

This talk will present scientific research activities on flow and thermal characterizations on micro fuel cell systems and solid oxide fuel cells and their material development activities. First, on the microchannel flow, two phase flow dynamics in the channels will be addressed for the water management of PEM fuel cells which has been the key issues in reliable fuel cell operations. This research was performed experimentally with a transparent microchannel bounded by a porous media at the bottom of the channel. The two phase flow in the channel is captured with visualization technique for flow regime transition study, and measured in flow data for flow dynamics analysis. As a result, flow regime map for the complex boundary conditioned channel is presented, and the flow friction analyses for single- and two-phase flow in the complex channel and porous media layer are addressed. Second, a novel approach for hydrogen generation method and its integrated micro fuel cell system development are explained. This hydrogen generator uses water for hydrogen supply to the fuel cells with a simple but state-of-art technology within a limited small volume, and is integrated into a stack and micro fuel cell system for mobile electronics applications. Stack development and control system engineering is addressed. In addition, this talk will also address the recent activities on graphene-based Non-precious group metal (PGM) new catalyst materials development for PEM fuel cells. Last, solid oxide fuel cell researches on tubular cells for small stationary applications are presented. This researches show the potentials to lower the operating temperature of ceramic-based solid oxide fuel cell by 200 degree Celsius just by way of controlling the quality of the thin dense electrolyte layer and porous anode and cathode functional layers, which can be achieved by the new method of dispersion technology and coating and sintering optimization which all are addressed in this talk.

Presenter Bio:

Dr. Lee has been an Assistant Professor in Mechanical and Industrial Engineering at NJIT since his join in January 2013 and is directing Advanced Energy Systems and Microdevices Laboratory. His primary research is to investigate both microscale thermal and flow characteristics in energy conversion systems such as fuel cells, and to characterize the electrochemical properties and catalytic reaction mechanisms, and to develop new catalytic materials based on graphene-based non-precious group metals for fuel cells and energy conversion systems. He's also interested in thermal transport in small scale electronic devices and flow dynamics in porous media through the small scale optical systems and imaging technologies.

Dr. Lee received his Ph.D. (2007) and M.S. (2004) in Mechanical Engineering at Stanford University, and his B.S. (1999) in Mechanical Engineering at Yonsei University, Seoul, Korea. During his study at Stanford, he researched on two-phase flow and thermal phenomena in porous wall-bounded microchannels in fuel cells using optical imaging methods. After his Ph.D., he worked as a Principal Research Engineer and the Leader of fuel cell research group at Corporate R&D Institute of Samsung Electro-Mechanics for over five (5) years, where he conducted fundamental researches on electrochemical property characterizations, flow and thermal analysis in micro fuel cells and catalytic reaction characterizations and ion- or electron- conductive nanoscale porous structured solid oxide fuel cells.

Dr. Lee has given a number of invited talks and lectures at universities, international conferences and world-leading companies on the topics of flow and thermal analysis and micro fuel cells and solid oxide fuel cells. He has served as reviewer for leading journal and conference session chair. He also has many granted and pending patents on fuel cells, and was the recipient of the Samsung Technology Award 2011 for his research on fuel cell technologies.

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