



West Virginia University

Department of Mechanical and Aerospace Engineering

MAE Graduate Seminar

Probing and mapping SOFC electrode reactions using *in situ* Raman spectroscopy

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Abstract

Raman spectroscopy, a form of vibrational spectroscopy, can provide structural and compositional information complementary to that from traditional *ex situ* and *in situ* characterization methods. Recently, we have built a state-of-the-art system capable of simultaneously performing *in situ* Raman spectro-microscopy and impedance spectroscopy to characterize electrode reactions in SOFCs under practical operating conditions while the gas composition is monitored by mass spectrometry. Raman spectroscopy provides unique identification of molecular species (adsorbates or reaction intermediates) and new phases through their vibration states. They often provide chemical bond information and molecular orientation under practical conditions. In addition, Raman spectro-microscopy offers capabilities for mapping where a specific reaction of interest is taking place. The Raman signals from electrode surfaces may be enhanced by depositing silver or gold nano-particles on the electrodes, creating the so-called surface-enhanced Raman scattering (SERS) effect to dramatically increase the sensitivity. Furthermore, both surface reaction kinetics and bulk properties of electrode materials may be deduced from the time dependence of *in situ* vibrational spectra collected during transition from one equilibrium state to another. When applied to an SOFC with *patterned* electrodes perturbed by an electrical, chemical, or optical stimulus, these techniques become very powerful in investigating into active reaction sites and other properties of various electrode materials, providing invaluable information that has never before been accessible.

Brief Biosketch

Dr. Meilin Liu is a Professor of Materials Science and Engineering (<http://www.mse.gatech.edu>) and Co-Director of the Center for Innovative Fuel Cell and Battery Technologies (<http://www.fcbt.gatech.edu>) at Georgia Institute of Technology, Atlanta, Georgia. He received his MS and PhD in Materials Science and Engineering from University of California at Berkeley. He is a recipient of the Outstanding Achievement in Research Program Development Award (Georgia Tech, 2003), Sustained Research Award (Sigma Xi, 2003), Best Faculty Paper Award (Sigma Xi, 2001), Outstanding Faculty Research Author Award (Ga. Tech, 1999), and a National Young Investigator Award (NSF, 1993-98). His research interests include defects and transport in solids, electro-physical and electro-chemical behavior of thin films and interfaces, solid state ionics, and electro-ceramics.