# UW Chemical Engineering

*Spring 2013 Seminar Series*

**Date:** Monday, May 13

**Time:** 4:00 - 5:00 p.m.

**Place:** PAA A110

## *Insights into Solid Oxide Fuel Cell Materials by In-Situ Neutron Diffraction*

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## Biography

Steven McIntosh is currently and Assistant Professor of Chemical Engineering at the Lehigh University. He received his Bachelor of Engineering with 1$^{st}$ class honors from the University of Edinburgh, Scotland, in 1999 and his MS and PhD in Chemical Engineering from the University of Pennsylvania in 2001 and 2004, respectively. His graduate work was conducted under the supervision of Prof. Raymond Gorte and his PhD was entitled 'Development of Direct Hydrocarbon Solid Oxide Fuel Cells'. He spent a postdoctoral period in the Inorganic Materials Science group of Prof. Henny Bouwmeester at the University of Twente, NL. Dr. McIntosh was an assistant professor at the University of Virginia from 2006 to 2010, prior to joining the faculty at Lehigh University in Fall 2010.

He was awarded a Marie Curie Intra-European Postdoctoral Fellowship from the European Union in 2004 and received a National Science Foundation CAREER award in 2007. His research interests are in electrochemistry, catalysis and solid-state ionics with a particular focus on solid oxide fuel cell development.

## Abstract

The promise of direct and efficient conversion of chemical to electrical energy makes fuel cell development an area of great technological interest. Solid Oxide Fuel Cells (SOFCs) are one of the most promising technologies to meet this goal. However, current SOFCs operate at temperatures above 700$^{o}$C. This high temperature increases costs and decreases cell lifetime. To overcoming this challenge we must develop materials that demonstrate high electrocatalytic activity and facile ion and electron transport at lower temperatures. A significant barrier to progress is a lack of experimental techniques that can probe the properties of these materials under high temperate working conditions in both oxidizing and reducing gas environments.

Neutron diffraction is one technique that can achieve this goal to reveal information relating to phase transition, order-disorder phenomenon, and the presence of anionic and cationic vacancies in crystalline oxides. Most powerfully, all of this information is collected in a single experiment over a wide variety of operating conditions. Analysis of these results enables visualization of diffusion pathways in ionic conductors, guiding future material development. This presentation will discuss results from a recently developed in-situ neutron diffraction cell developed for the POWGEN beamline at the Spallation Neutron Source, Oak Ridge National Laboratory. Results will be presented for a variety of materials to demonstrate the versatility of this technique.