University of Central Florida
Department of Chemistry Seminar Series – Fall Semester 2023
Friday, September 15, 9:00 AM, Location CB2 105

Atomic-scale Insights into Electrocatalyst Structure and Function

Prof. Anthony Shoji Hall

Department of Materials Science and Engineering
Johns Hopkins University, Baltimore, MD 21218

Host: Prof. Fernando Uribe-Romo

The development of efficient renewable energy conversion and storage devices to curb climate change is one of the most important challenges of the 21st century. This can be addressed by using renewable electricity to manufacture chemical fuels and synthetic precursors, or by generating electricity with carbon-neutral fuel cell devices. However, electrocatalytic processes are hampered by low efficiencies and poor reaction selectivity because of a lack of rational methods available to create controllable catalyst materials with the preferred electrochemical activities. In this seminar Prof. Hall will discuss the use of intermetallic materials, which are alloys that display high electrocatalytic activities because their well-defined compositions and long-range atomic scale ordering enable predictable geometric and electronic interactions, in contrast to the more widely studied solid-solution type alloys. However, intermetallic materials are difficult to synthesize in nanomaterial form because conventional synthesis methods offer poor control over the composition, phase, and morphology. I will discuss our efforts on the synthesis, stability, and catalytic activity of intermetallics prepared by electrochemical methods at room temperature and atmospheric pressure. Our strategies include the use of electrochemically induced phase transformations which enables us to convert a base metal rich alloy to an intermetallic richer in nobler metal by removal of the base metal, and the direct production of OIC materials by electrochemical deposition. We will also discuss how we leverage the atomically precise configuration of atoms within intermetallics to reveal detailed insights into how a material's structure regulates its electrochemical properties. Developing new methods for preparing intermetallic materials under ambient conditions is essential for designing catalysts for the next generation of renewable energy conversion devices.

Bio:

Anthony Shoji Hall is an Assistant Professor in the Department of Materials Science and Engineering at the Johns Hopkins University (JHU). Prior to joining JHU he was a Postdoc at MIT in the Chemistry Department. He earned his PhD in Chemistry from Penn State in 2014 and a B.S. in Chemistry from UCLA in 2010. Dr. Hall has received numerous awards for his research such as the NSF CAREER award, the Electrochemical Society (ECS) - Toyota Young Investigator Fellowship and was selected as a Scialog Fellow for Advanced Energy Storage. The Hall Group is interested in enhancing the field of electrocatalysis, with a particular focus on renewable energy storage and conversion reactions. By using ordered intermetallic materials, known for their distinct compositions and long-range atomic-scale ordering, the Hall group aims to develop insights into electrocatalyst structure and function. Concurrently, we are engaged in understanding the role of water in modulating proton transport and how the interfacial water structure influences electrochemical reactivity.