Materials Science and Engineering Department

Fall Seminar Series

Relevance of Proton-insertion Coupled Electron Transfer for Aqueous Energy Storage and Conversion

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Technological interest in electrode materials with long-term stability and reactivity in aqueous electrolytes is motivated by the urgent need for large scale, safe, and low-cost electrochemical energy storage and conversion. Transition metal oxides are an important class of redox-active electrode materials for aqueous electrochemical technologies including batteries, fuel cells, and electrolyzers. From a fundamental perspective, the electrochemistry of metal oxides in aqueous electrolytes across the entire pH scale inevitably involves protons. These can interact with transition metal oxides via numerous reactions, including water electrolysis, surface adsorption and bulk insertion, and electrodeposition/stripping. Such proton-coupled reactions are dependent on the pH (especially the interfacial pH), and can involve proton donors beyond H3O+. In this seminar, I will discuss our work on understanding proton-insertion coupled electron transfer (PICET) in metal oxides for aqueous energy storage and conversion. This includes PICET into hydrous oxides, the interplay of PICET with the hydrogen evolution reaction, and the role of acid electrolyte composition on the speciation of proton-coupled electrochemical reactions. The metal oxides that I will discuss include hydrous tungsten oxides and metastable hydrogen titanates. Our work provides fundamental understanding of PICET into metal oxides to advanced aqueous energy storage and conversion technologies.

Veronica Augustyn is the Jake and Jennifer Hooks Distinguished Scholar in Materials Science and Engineering and Associate Professor in the Department of Materials Science and Engineering at North Carolina State University. She received her B.S. from the University of Arizona and Ph.D. from the University of California, Los Angeles, both in Materials Science and Engineering. She was a postdoctoral fellow at the Texas Materials Institute, University of Texas at Austin. Her research focuses on the electrochemistry of materials for energy and environmental applications, including interfacial phenomena, insertion mechanisms, and confinement effects. She is the recipient of several awards, including the National Science Foundation CAREER, the Department of Energy Early Career, and Sloan Research Fellowship. She is also the founder and faculty advisor of an award-winning international project, SciBridge, a student-led group that develops renewable energy research and education collaborations between universities in Africa and the U.S. She is an Associate Editor of the Journal of Materials Chemistry A and Materials Advances, and serves on the editorial advisory boards of ACS Energy Letters, Physical Review Materials, Energy Storage Materials, and ACS Nanoscience Au.

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