Abstract:
As the world energy demand and carbon dioxide emissions continue to rise, there is an increasing need to shift away from carbon containing energy sources, such as coal, oil, and natural gas, to renewable energy. Currently, the transition is partially hindered by limitations in the performance of the available energy storage and conversion devices. My research focuses on improving the performance of these devices through a combination of electrochemistry with X-ray absorption spectroscopy (XAS) characterization. XAS is a synchrotron based technique, which can provide information about the electronic structure and local bonding in electrode materials and, as a result, can be used to identify specific properties of materials that lead to superior electrochemical performance. I will discuss applications of XAS characterization to three different electrochemical research areas: development of manganese oxide based catalysts for the oxygen reduction and evolution reactions, improving the understanding of hydrogen absorption in palladium electrocatalysts, and identification of the charging mechanism in lithium-sulfur batteries.