Advances in electrochemical energy storage are critical and may be a key factor in the ability to fully utilize renewable energy sources such as wind, hydroelectric, and geothermal power. Additionally, transportation, personal electronics and biomedical applications have ever increasing demands for portable power. Despite remarkable advances in the optimization of electrochemically active materials over the last several decades, there remains an urgent need to enhance utilization efficiencies and to develop materials that can safely deliver both high power and energy density.

We are pursuing the investigation of factors that influence battery life time as well as those that affect ion and electron transport properties of electroactive materials. Electron transport will be described through the study of bimetallic materials capable of redox initiated in-situ generation of conductive nanoparticles with the formation of a conductive network by reduction displacement reactions. Interfacial effects on ion transport will be described including anode-cathode cross-talk interactions. Advanced characterization techniques including in-situ and operando measurements will be featured to gain mechanistic insight.