CHEMICAL AND BIOLOGICAL ENGINEERING
SEMINAR ANNOUNCEMENT

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“Molecular Approaches toward the Development of Active and Selective Catalysts for Energy and Chemical Conversion”

MONDAY, FEBRUARY 27, 2017
12:00PM
SciTech Room 136
Dwindling fuel resources and high levels of CO₂ emissions have increased the need for renewable energy resources and more efficient energy conversion and storage systems. The goal of our research group is to design active, selective and stable electrocatalysts/catalysts for these processes using a combination of theoretical techniques, state of the art synthesis and characterization approaches along with controlled reactivity studies. This talk will highlight some of our recent work on designing (i) the nanostructure of metal oxide electrocatalysts for enhanced activity in energy conversion and storage, and (ii) catalytic systems for biomass conversion.

First, I will discuss our work on designing layered nickelate oxide electrocatalysts for electrochemical oxygen reduction and evolution reactions. These processes play an important role in fuel cells, electrolyzers and Li-air batteries. We have utilized density functional theory (DFT) calculations to identify the factors that govern the activity of nickelate oxides toward these processes. Using a reverse microemulsion approach we demonstrate an approach for synthesizing nanostructured nickelate oxide electrocatalysts with controlled surface structure. These nanostructures are thoroughly characterized using atomic-resolution high angle annular dark field (HAADF) imaging along with electron energy-loss spectroscopy (EELS) performed using an aberration corrected scanning transmission electron microscope (STEM). Controlled kinetic isotopic and electrochemical studies are used to develop structure/performance relationships to identify nickelate oxides with optimal electrocatalytic activity. Secondly, I will talk about our efforts on designing efficient catalytic systems for biomass conversion processes. Development of active and selective catalysts for biomass conversion is critical in realizing a renewable platform for fuels and chemicals. I will highlight some of our recent work on the development of selective polyoxometalate-based catalysts for epimerization of sugars, and core-shell catalytic nanostructures for selective hydrodeoxygenation of biomass-derived alcohols.