THE OHIO STATE UNIVERSITY

The William G. Lowrie Department of Chemical and Biomolecular Engineering Graduate Program Cordially invites you to attend a seminar on

Embracing the Complexity of Heterogeneous Catalytic Structures: Nonstoichiometric Mixed Metal Oxides and 3-Dimentionally Engineered Metal Catalysts for Energy and Chemical Conversion

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Thursday, October 21, 11:30 AM
130 Koffolt Lab
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Bio

Eranda Nikolla is a Professor in the Department of Chemical Engineering and Materials Science at Wayne State University. Her research interests lie in the development of heterogeneous catalysts and electrocatalysts for chemical conversion processes and electrochemical systems (i.e., fuel cells, electrolyzers) using a combination of experimental and theoretical techniques. Dr. Nikolla received her Ph.D. in Chemical Engineering from University of Michigan in 2009 working with Prof. Suljo Linic and Prof. Johannes Schwank in the area of solid-state electrocatalysis. She conducted a two-year postdoctoral work at California Institute of Technology with Prof. Mark E. Davis prior to joining Wayne State University. At Caltech, she developed expertise in synthesis and characterization of meso/microporous materials and functionalized surfaces. Her group's impact to catalytic science has been recognized through the National Science Foundation CAREER Award, the Department of Energy Early Career Research Award, Camille Dreyfus Teacher-Scholar Award, the Young Scientist Award from the International Congress on Catalysis, the 2019 ACS Women Chemists Committee (WCC) Rising Star Award, and the 2021 The Michigan Catalysis Society Parravano Award for Excellence in Catalysis Research and Development.

Abstract

Shaping the energy landscape toward renewable energy resources is a contemporary challenge that will require significant advancements in the development of catalysts/electrocatalysts for energy and chemical conversion. The goal of our research group is to design active, selective and stable heterogeneous catalysts and electrocatalysts for energy and chemical conversion processes. We have focused on utilizing the versatile structure of non-stoichiometric mixed metal oxides, along with controlling the 3-dimensional environment of heterogenous catalytic sites via "inverted" catalytic architectures, as potential avenues for addressing limitations with the current state-of-the-art catalytic/electrocatalytic systems for energy and chemical conversion processes.

In this presentation, I will discuss our work on designing non-stoichiometric mixed metal oxide electrocatalysts for electrochemical oxygen reduction and evolution reactions (ORR/OER). These processes play an important role in electrochemical energy conversion and storage technologies, such as fuel cells, electrolyzers and Li-air batteries. We have utilized density functional theory (DFT) calculations to identify the factors that govern the activity of non-stoichiometric mixed metal oxide for oxygen electrocatalysis. Controlled synthesis and electrochemical studies are used to validate theoretical predictions and identify non-stoichiometric mixed metal oxides with optimal oxygen electrocatalytic activity and stability. In the second part of my talk, I will highlight our efforts on controlling the 3-dimensional environment of heterogeneous catalytic sites via "inverted" metal@metal oxide catalytic architectures or surface bound ligands on metal nanoparticles as levers to tune activity/selectivity in thermal catalytic reactions. Specifically, I will discuss our recent work on utilizing reducible metal oxide encapsulated noble metal catalytic structures to promote hydrodeoxygenation (HDO) of biomass-derived compounds. We have demonstrated that the enhancement in HDO activity/selectivity induced by the encapsulation of the metal nanoparticles with an oxide film results from the high interfacial contact between the metal and metal oxide sites, and the restrictive accessible conformations of aromatics on the metal surface.