

The William G. Lowrie Department of Chemical and Biomolecular Engineering Graduate Program Cordially invites you to attend a seminar on Navigating Convoluted Electro-and Photocatalytic Structures For Enhanced Activity, Selectivity, and Stability

> **Dr. Samji Samira** Postdoctoral Scholar University of California, Santa Barbara

January 30, 2024, 11:30 AM 130 Koffolt Lab, CBEC 151 W Woodruff Ave Reception at 11:00 AM - CBEC Lobby

<u>Bio</u>

Samji Samira is a postdoctoral scholar in Prof. Phil Christopher's group at the Department of Chemical Engineering, University of California, Santa Barbara. Samji earned his Ph.D. in Chemical Engineering from Wayne State University under the supervision of Prof. Eranda Nikolla. Samji's research interests include: (i) design of electrocatalytic active site environments via precise engineering of the electrode-electrolyte interfaces, and (ii) development of manipulatable materials which can serve as both light harvesters, as well as active centers. His graduate research has been recognized with various awards including the Ralph H. Kummler Award for distinguished achievement in graduate student research, Young Scientist Presenter Award from the International Congress on Catalysis and Kokes award from the North American Catalysis Society.

Abstract

All pathways towards net zero emissions in the 21st century will involve a transition from the use of fossil-based resources for process energy to renewable electricity. In the context of this transition, electron and photon driven chemistries offer a versatile toolkit by accessing redox and excited states. At the core of these radical technologies is the rational design and development of heterogeneous catalysts that drive relevant transformations. This gives rise to the need for the identification of chemical and physical properties of active sites that describe not just their activity, but also their selectivity and stability.

In this seminar, I will first discuss a systematic approach to identify empirically measurable chemical and physical properties of active site environments in working catalysts that govern not just their electrocatalytic activity, but also selectivity and stability. This will be showcased for perovskite oxide electrocatalysts using electrochemical oxygen reduction (ORR) and evolution reactions (OER) reactions – key bottleneck reactions for the generation and use of clean hydrogen – as probe reactions. It is found that the empirically measured average strength of the surface metal-oxygen bonds in the perovskite oxide lattice controls their overall electrocatalytic performance. This opens up avenues to use empirically measurable properties of working, non-model catalytic centers to identify optimal electrocatalysts. Second, I will discuss strategies to impart selectivity, as well as develop insights into deactivation mechanisms for both thermal- and photocatalytic non-oxidative methane activation to aromatics and hydrogen. We find that metal supported group-III nitrides overcome the general conception of the requirement of a stereoselective environment, by converting methane to aromatics. The ideas towards rational electroand photocatalytic design that I will discuss here, can be leveraged to steer new pathways towards reactivity, selectivity, and stability for the direct use of renewable electricity in energy conversion and chemical manufacturing.