PennState College of Engineering | CHEMICAL ENGINEERING

Chemical Engineering Seminar Series

Dr. Chris Li

Postdoctoral Scholar

University of Toronto

Thursday,
January 30, 2020

350 Health & Human Development Building

10:50-11:50 a.m.

Rationally Guided Design of Electrocatalysts and Systems for CO2-to-Fuels Using Renewable Electricity

Abstract

The electrochemical CO2 reduction reaction (CO2RR) to multi-carbon products, such as ethanol and ethylene, offers a route to produce fuels and chemicals from renewable energy. CO2RR technology is a promising solution to address the intermittency of renewable electricity and, ultimately, enable renewable fuels to contribute to displacing fossil fuels.

In CO2RR to multi-carbon products, the electrocatalyst plays a vital role in determining the activity as well as the selectivity of the reaction. The design of a well-engineered system for CO2 electrolysis is as important as that of the electrocatalyst. The transport of reactants, the local pH control at the catalyst interface, and the structural integrity of the substrate, determine the industrial relevance of the CO2 electrolysis device and system.

In this talk, we will introduce the recent developments in electrocatalysts and electrolyzer design. For electrocatalyst designs, we took advantages of computationally tools to identify the reaction intermediates stability and design catalyst that can steer the CO2RR selectivity between ethylene and ethanol. We will show that the local surface concentration of CO is essential for the formation of ethanol. For electrolyzer engineering, we focused on maximizing the CO2 utilization of the full capture-to-products process by designing a novel system configuration that is capable of carbonate electrolysis via the incorporation of a bipolar membrane. We report current densities that are in the 100+ mA/cm2 range and 100+ hours of continuous CO2RR operation.

Biosketch

Chris completed his B.S. degree in Chemical Engineering at the University of California, Davis in 2010. He subsequently worked in industries for three years as a research and development engineer before joining Penn State for graduate study. He received his Ph.D. degree in Chemistry (2018) with Prof. Tom Mallouk and his dissertation focuses on the design of efficient CO2 electrocatalysts and electrolyzer. Chris joined the Sargent group at the University of Toronto for a postdoctoral position in July 2018 and is currently exploring different electrochemical reactions and system designs to achieve a carbon neutral cycle with a multidisciplinary approach across chemistry, chemical engineering and materials science.