COLLEGE OF ENGINEERING
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Mechanical Engineering Seminar Series

Importance of Transport in Electrochemical Energy-Conversion Technologies

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at Lawrence Berkeley National Laboratory
and co-Director of the Million Mile Fuel Cell Truck Consortium

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Room 3150 DOW

4:00 p.m.

This seminar will also be streamed live at the following link

ME Seminar Zoom link (QR Code below)

Password 413824

Abstract

As electrochemical technologies become increasingly important in our energy paradigm, there is a need to examine them holistically. Furthermore, for such technologies to become practical, they need to operate at high current densities to minimize various cell costs. This operating space necessitates the need for efficient transport of reactants and removal of products from the reaction site. For example, one of the main challenges towards achieving low-cost fuel cells and electrolyzers stems from multiphase mass-transport limitations, especially near the reaction site. In addition, high-efficiency fuel generators performing CO_2 reduction are limited by mass-transport limitations in traditional aqueous systems due to CO_2 interactions/solubility and boundary-layer thickness. To circumvent these issues, gas-diffusion electrodes (GDEs) are considered wherein the reactants and products are fed or removed in a vapor form into a porous 3-D electrode. In this talk, we will explore the various tradeoffs endemic in GDE architectures for various electrochemical reactions including CO_2 reduction and O_2 and H_2 consumption and evolution. Such tradeoffs are explored experimentally and quantified through multiphysics modeling of the cells including breakdowns of the various limiting phenomena at both the micro and macroscales, where the local conditions and environment around the reaction center impact reactivity. It will be shown how transport phenomena dominate a lot of the performance and selectivity of the catalysts, which is critical to understand to improve overall performance. Different GDE design architectures will be explored and their intrinsic tradeoffs noted including complex interplay of hydration, reactant concentration, and both homogeneous and heterogeneous reactions. In particular, full vapor-phase motifs will be discussed including complex water management through polymer electrolytes. In addition, experimental data on both GDEs and model, microelectrode solid-state systems for the various electrochemical reactions will be presented and results rationalized through understanding the various concentration and ionic overpotentials.

Bio:

Adam Z. Weber is a Senior Scientist and Leader of the Energy-Conversion at Lawrence Berkeley National Laboratory and co-Director of the Million Mile Fuel Cell Truck Consortium. He received his PhD from UC Berkeley and MS and BS degrees from Tufts University. His current research involves understanding and optimizing electrochemical technologies using advanced modeling and diagnostics. Dr. Weber has coauthored over 175 peer-reviewed articles and 10 book chapters and developed many widely used models for them and their components. He is the recipient of a number of awards including a Fulbright, 2012 Presidential Early Career Award for Scientists and Engineers (PECASE), 2014 Charles W. Tobias Young Investigator Award of the Electrochemical Society, and 2016 Sir William Grove Award from the International Association for Hydrogen Energy. He is a Fellow of The Electrochemical Society and the International Association of Advanced Materials.

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