Penn Engineering
University of Pennsylvania
Chemical and Biomolecular Engineering

Fall 2023 Seminar Series

HONG YANG

"Design of Solid-state Nanomaterials for Electrocatalysis: A Case Study of Oxygen Evolution Reaction Electrocatalysts"

Wednesday
September 27th, 2023
3:30 PM
Wu and Chen Auditorium
Levine Hall

Richard C. Alkire Endowed Chair Professor
Chemical Engineering
University of Illinois at Urbana-Champaign

ABSTRACT

High-level control of atomic and surface structures is a hallmark of the application of nanomaterials in a range of electrochemical and electrocatalytic devices, such as water electrolyzer. They play critical roles in our effort to develop energy conversion and storage technologies that have net zero carbon impacts. Nanostructured metal oxides made for catalyzing the oxygen evolution reaction (OER) is one representative example. Unlike the traditional heterogeneous catalysis, both bulk and surface properties are important in the design of active and durable electrocatalysts.This is because besides the adsorbate evolution mechanism (AEM), lattice oxygen mechanism (LOM) is often involved in the catalytic cycle. In this talk, I will present our recent work on the synthesis-structure-electrocatalytic property relationship of complex oxides that can be described in a generic formula of AxByOz, where A and B can be a single metal cation or mixed cations located at a given lattice site. We have examined several archetypes of oxide structures, including perovskite, pyrochlore, spinel, and Ruddlesden-Popper (RP) phase compounds and their site-mixed solids, all of which are found to be active for OER under either acid or base conditions. Our results indicate defect engineering in these solids is particularly important for OER catalysis. Thus, it is essential, besides a good understanding of heterogeneous catalysis, one needs to take a solid state chemistry view in order to uncovering the catalyst design for optimal performance. How to regulate the cation sites and oxygen defect chemistry for enhancing the bond and lattice stability of key structural constituents can be important. The new understandings should inform the approach to the fabrication of earth-abundant oxide electrocatalysts for hydrogen production and utilization.

BIO

Dr. Hong Yang is the Richard C. Alkire Endowed Chair Professor of Chemical Engineering at University of Illinois at Urbana-Champaign (UIUC). He received his B.Sc. degree from Tsinghua University (1989), and Ph.D. degree from University of Toronto (1998). He did his postdoctoral research at Harvard University as an NSERC Canada Postdoctoral Fellow. He worked through the academic ranks at University of Rochester between 2001 and 2011 and joined the UIUC faculty as Full Professor in 2012. He has been an Associate Editor for Science Advances - the online extension of Science magazine since 2020 and currently also serves as an Editorial Board Member of five other journals. Dr. Yang is an NSERC Canada Doctoral Prize recipient, a US National Science Foundation CAREER Award winner, and an elected Fellow of American Association for the Advancement of Science (AAAS). His current research is focused on the design of electrocatalysts and catalysts to address critical issues for green energy technologies, including hydrogen production, low-temperature fuel cell system, upgrade of bio-crude oil, and application of rare earth elements in electrocatalysis/electrochemical processes.