CHEMICAL ENGINEERING

SEMINAR SERIES

BILGE YILDIZ

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Associate Professor of Nuclear Science and Engineering, and Associate Professor of Materials Science and Engineering
MIT

Oxygen reduction kinetics on perovskite oxides: effects of Strain and surfaces

ABSTRACT: Interfaces between dissimilar oxides are attracting significant interest for their potential role in accelerating charge transport and surface reaction kinetics. If well understood and controlled, they can provide a new way to enable high-performance solid-oxide fuel cells, separation membranes as well as fast switching memristors. For example, recent studies have demonstrated that cobaltite hetero-interfaces exhibit orders of magnitude faster oxygen reduction kinetics compared with either single phase. The interfacial strain fields and electronic interactions between the two phases as well as the effect of these interactions on the surface chemistry are the likely mediators behind such an unprecedented enhancement. The underlying mechanisms must be understood quantitatively, so that we can go beyond isolated and empirically found interface or surface structures to rationally designing dissimilar oxide interfaces with superior properties. In this talk, I will present our findings on how elastic strains, dislocations, and surface chemistry affect the defect chemistry and the charge transport/transfer kinetics, by using atomistic computations and model experiments using thin films. These recent results are encouraging for an improved understanding of oxide hetero-interfaces and surfaces at elevated temperatures, and could enable the discovery of new interfaces with fast oxygen transport and oxygen reduction kinetics.

BIOGRAPHY: Bilge Yildiz is an associate professor in the Nuclear Science and Engineering and the Materials Science and Engineering Departments at Massachusetts Institute of Technology (MIT), where she leads the Laboratory for Electrochemical Interfaces. She received her PhD degree at MIT in 2003 and her BSc degree from Hacettepe University in Turkey in 1999. After working at Argonne National Laboratory as research staff, she returned to MIT as an assistant professor in 2007. Her research centers on molecular-level studies of charge transfer kinetics on surfaces and thin films at elevated temperatures, under stress and in reactive gases, by combining in situ surface sensitive experiments with first-principles calculations and novel atomistic simulations. The scientific insights derived from her research impact the design of novel surface chemistries for efficient and durable solid oxide fuel/electrolysis cells, solid state lithium ion batteries, memristive devices, and for corrosion resistant films in a wide range of extreme environments as in nuclear energy generation and oil exploration. Honors include the Charles Tobias Young Investigator Award of the Electrochemical Society, the Somiya Award of the International Union of Materials Research Societies, and an NSF CAREER award.

RECEPTION 3:30 • LECTURE 4:00 – 5:00
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