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290 SEMINAR SERIES PRESENTS

Prof. Yang Shao-Horn

Massachusetts Institute of Technology
Department of Mechanical Engineering

Activating Oxygen Chemistry for Sustainable Energy

4pm - Thursday, October 15th 2015 in ENGR II 1519

A critical element for sustainable energy realization is to have efficient energy conversion and storage. Activating oxygen chemistry is central to enable efficient redox of small molecules of energy consequence, including photoelectrochemical and electrochemical water-splitting, regenerative fuel cells, and metal-air batteries. Probing a fundamental catalyst "design" principle" that links surface structure and chemistry to the catalytic activity can guide the search for highly active catalysts that are cost effective and abundant in nature. Recent advances in identifying the design principles and activity descriptors of transition metal oxides will be presented. We will show that these fundamental concepts can be used to tune transition metal oxide surfaces with much enhanced activities for oxygen electrocatalysis. We will also discuss how oxide bulk electronic structures can influence oxygen electrocatalysis, from which proton-coupled and -decoupled electron transfer mechanisms are discussed. Lastly, connecting bulk to surface electronic structures is challenging but much needed to provide mechanistic insights, and some in-situ synchrotron X-ray measurements to this end will be discussed.

Yang Shao-Horn is W.M. Keck Professor of Energy, Professor of Mechanical Engineering, Materials Science and Engineering and Research Laboratory of Electronics at MIT. Her research is centered on the chemical physics of surfaces with emphasis on metal oxides, searching for descriptors of catalytic activity, wetting properties and ion transport, and design materials for solar fuel and batteries including electrochemical/photoelectrochemical water splitting and CO2 reduction, ion/electron storage, and ion conductors.

Professor Shao-Horn's research includes extensive experimental components including synthesis of well-defined surfaces and nanostructured materials, and investigation of processes at the surfaces/interfaces using electrochemical methods coupled with ex situ and in situ X-ray-based and electron-based spectroscopy. These experimental components are used in conjunction with Density Functional Theory computation efforts to develop new, physically based reaction mechanisms and design principles of materials.

Professor Shao-Horn has published ~200 archival journal papers and has advised ~50 M.S. and Ph.D. students and Postdoctoral Associates at MIT. Select honors and awards include the Charles Tobias Young Investigator Award from the Electrochemical Society, the Tajima Prize from the International Society of Electrochemistry, Gail E. Kendall (1978) Professor of Mechanical Engineering and AAAS Fellow.

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