Yang Shao-Horn is the Gail E. Kendall Chair in the Department of Mechanical Engineering and Department of Materials Science and Engineering at MIT. Her research is centered on understanding the influence of the surface electronic structures of thin films and nanomaterials on reactivity, and applying fundamental understanding to design new materials for lithium storage and electrocatalysis of small molecules such as oxygen reduction, water splitting and methanol oxidation. She obtained her Ph.D. in Metallurgical and Materials Engineering from Michigan Technological University in 1998 before working as a staff scientist at Eveready Battery Company until 2000. She joined MIT in August 2002 after a two-year NSF International Research Fellowship at the Institute of Condensed Matter Chemistry in Bordeaux, France. Shao-Horn’s select honors include Energy and Environmental Science Advisory Board 2011; Tajima Prize of the International Society of Electrochemistry 2008; Charles W. Tobias Young Investigator Award of the Electrochemical Society 2008; Dupont Young Faculty Award 2006; MIT Presidential Energy Research Council.

“Enabling Efficient Oxygen Electrocatalysis for Electrochemical Energy Storage”

The development of clean and sustainable energy is one of the most important scientific challenges in the 21st century. A critical element for sustainable, renewable energy implementation is to enable efficient electrochemical energy conversion and storage technologies. Oxygen electrocatalysis is central to the efficiencies of direct-solar and electrolytic water-splitting devices, 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. While such a design concept exists for precious metal catalysts, little is known about the design principles for oxygen electrocatalysis on transition metal oxides. Recent advances in identifying the design principles and activity descriptors of transition metal oxides will be discussed. We will show that these fundamental concepts can be used to tune transition metal oxide surfaces with enhanced catalytic activities. Moreover, we will discuss how in-situ ambient pressure X-ray photoelectron spectroscopy measurements can reveal the changes in oxide surface chemistry as a function of temperature, potential and oxygen partial pressure, which provide insights into reaction mechanisms and active sites that govern oxygen electrocatalysis.