Activity and Stability Trends for Oxygen Evolution Reaction Electrocatalysts

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Electrocatalysis of the oxygen evolution reaction (OER) is critical to the operation of electrolyzers. Currently, large-scale electrochemical production of hydrogen from water splitting is constrained by two limitations: 1) high overpotentials for the OER and 2) lack of stability of the electrode materials. While a large number of materials have been tested for the OER in alkaline and acid environments, the efforts were guided by a trial-and-error and/or a combinatorial approach with a resulting lack of studies focusing on systematic understanding of fundamental catalytic properties of the OER on well-characterized materials.

In this presentation, using well-defined extended surfaces we demonstrate that, for proton exchange membrane (PEM) electrolyzers, activity and stability depend on the nature of the metal-oxide interface. We begin our exploration of the OER on well-defined surfaces of precious metal alloys, their hydroxides and oxides in acid electrolytes. While thermal oxides are the most relevant to commercial applications for OER catalysts in PEM type electrolyzers, from a basic science approach using metal surfaces as a starting point is more instructive as we can monitor the formation of the oxide, changes in oxidation state, along with stability and activity.