

Chemical Engineering Seminar Series

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350 Health & Human
Development Building

10:50-11:50 a.m.

Nanoscale Engineering of Efficient Oxygen Reduction Electrocatalysts by Tailoring the Local Chemical Environment of Pt Surface Sites

Abstract

The oxygen reduction reaction (ORR) is the major source of overpotential loss in low-temperature fuel cells. Expensive, Pt-based materials have been found to be the most effective catalysts, but exploration of alternatives has been hampered by stability constraints at the typical operating conditions of low pH and high potential.

I will discuss our studies of elementary mechanism of ORR on various metal electrodes using kinetic and micro-kinetic analysis of reaction pathways and quantum chemical calculations. These studies allowed us to identify the elementary steps and molecular descriptors that govern the rate of ORR. Using these performance descriptors we have been able to identify families of Pt and Ag-based alloys that exhibit superior ORR performance in acid and base respectively.

We have synthesized these alloys to demonstrate the superior ORR activity with rotating disk electrode experiments. We have also performed thorough structural characterization of the bulk and surface properties with a combination of cyclic voltammetry, x-ray diffraction, and electron microscopy with spatially resolved energy-dispersive x-ray spectroscopy and electron energy loss spectroscopy.

Biosketch

Prof. Linic obtained his PhD degree, specializing in surface and colloidal chemistry and heterogeneous catalysis, at the University of Delaware in 2003. He was a Max Planck postdoctoral fellow with Prof. Dr. Matthias Scheffler at the Fritz Haber Institute of Max Planck Society in Berlin (Germany), working on first principles studies of surface chemistry. He started his independent faculty career in 2004 at the Department of Chemical Engineering at the University of Michigan in Ann Arbor where he is currently the Martin Lewis Perl professor of chemical engineering. He was also a Hans Fischer Faculty Fellow at the Department of Chemistry at Technical University in Munich.

Prof. Linic's research has been recognized through multiple awards including the 2017 Emmett Award by The North American Catalysis Society, the 2014 ACS (American Chemical Society) Catalysis Lectureship for the Advancement of Catalytic Science, awarded annually by the ACS Catalysis journal and Catalysis Science and Technology Division of ACS, the 2011 Nanoscale Science and Engineering Forum Young Investigator Award, awarded by American Institute of Chemical Engineers, the 2009 ACS Unilever Award awarded by the Colloids and Surface Science Division of ACS, the 2009 Camille Dreyfus Teacher-Scholar Award awarded by the Dreyfus Foundation, the 2008 DuPont Young Professor Award, and a 2006 NSF Career Award. Prof. Linic has presented more than 200 invited and keynote lectures and published more than 75 peer reviewed articles in leading journals in the fields of catalysis and general science. He serves as the associate editor of ACS catalysis journal.