"Catalysis on Plasmonic Metal Nanoparticles: Opportunities for Highly Selective Chemical Conversion"

Wednesday
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3:00 pm
Wu and Chen Auditorium
Levine Hall

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Abstract

Metal nanoparticles are used as commercial thermal catalysts for many chemical reactions. These thermal reactions usually require relatively high temperatures, and the distribution of the products is governed by the ground-state, free-energy landscape. They offer limited opportunities to tune the product selectivity. We recently made an important breakthrough by showing that relatively small plasmonic metal nanoparticles, illuminated with visible light, can activate chemical reactions on their surfaces in an alternative mechanism. We showed that these chemical transformations are driven by the energetic charge carriers that are formed on the surface of the nanostructures upon their interaction with resonant light and transferred from plasmonic nanoparticles to the reacting adsorbates. This has led to an entirely new field of chemical conversion, often referred to as plasmonic catalysis. Unlike in the case of phonon-driven reactions, it is, in principle, possible to change -- and improve, through targeted design of nanostructures -- the product selectivity, compared with phonon-driven thermal reactions. I will discuss the physical features of plasmonic nanoparticles that make them ideal for the charge transfer mediated reactions, the mechanism of charge-carrier driven chemical transformations on metals, the mechanisms behind the plasmon-induced charge injection processes, and the approaches to engineer these nanostructures, so that they can support specific chemical transformations to make value-added products with high selectivity and at lower temperatures.

Bio

Prof. Linic obtained his Ph.D. 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 Class of 1983 Faculty Scholar Professor of Chemical Engineering. 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 the 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 150 invited and keynote lectures and published more than 60 peer reviewed articles in leading journals in the fields of catalysis and general science. He serves as the associate editor of the ACS Catalysis journal.

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