Anders Nilsson

Probing Catalysis in Real Time

In heterogeneous catalysis, reactants adsorbed on surfaces are converted to products, which eventually desorb via various intermediates. The transition state separates reactants and intermediates from products and the free energy required to reach it determines the kinetics of an elementary chemical reaction. Many surface reaction intermediates are, however, transient species with a short residence time and the population of species in the transition state region is near-zero making their observation a challenge during steady state conditions. Ultrafast pump-probe techniques have opened up opportunities by promoting a sufficient population of molecules in transient states to allow detection on short time scales. Here, recent results on probing chemical reactions on surfaces using the x-ray free-electron laser Linac Coherent Light Source at SLAC National Accelerator Laboratory will be presented. Four examples will be shown: CO desorption, oxygen activation, CO oxidation, and CO hydrogenation on Ru(0001). We demonstrate that both transient intermediates and the transition state region can be detected in surface chemical reactions.

Anders Nilsson received a Ph.D. in physics at Uppsala University, Sweden (1989) in the laboratory created by Kai Siegbahn. He is currently a professor in Chemical Physics at Stockholm University, and in Photon Science at the SLAC National Accelerator Laboratory and Stanford University. His research interests include synchrotron radiation and x-ray laser spectroscopy and scattering, chemical bonding and reactions on surfaces, ultrafast science heterogeneous catalysis, electrocatalysis in fuel cells, photocatalysis for converting sunlight to fuels, structure of water and aqueous solutions. Science Magazine selected his work on water in 2004 as one of the 10 most important scientific breakthroughs of the year.

Thursday, November 19, 2015 | 3:00 p.m.

Bldg. 402 | APS Auditorium
Argonne National Laboratory

APS Colloquium