Near-Field Vibrational Spectroscopy and Imaging of Chemical Species on Nanoparticles during Catalytic (de)Hydrogenation

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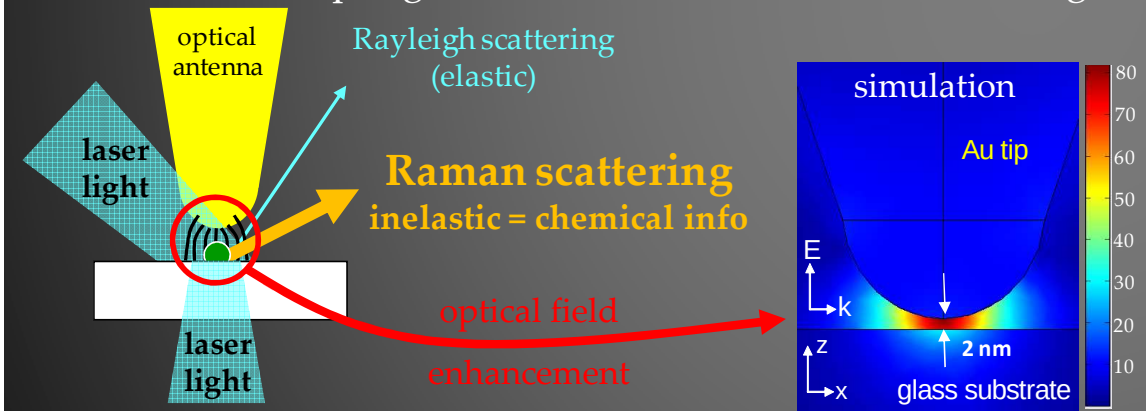
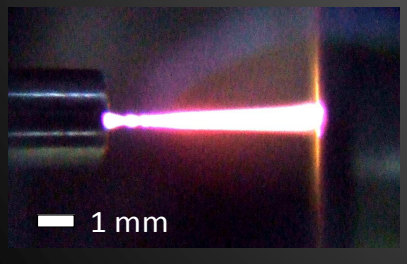
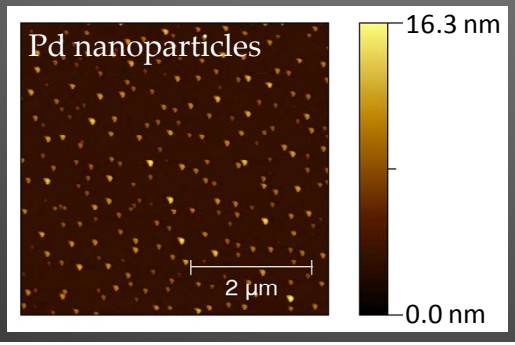
Interaction of laser light with free electrons in metallic nanostructures (also known as *plasmonics*) can be used to focus optical fields to dimensions far below the diffraction limit. These spatially-confined optical fields can be used to excite and detect molecular vibrations of chemical species on a surface when the field-enhancing optical antenna or "tip" is brought in close proximity (few nm). Excitation of molecular bonds by the probe light results in Raman scattering [an inelastic process] where some of the light leaving the surface has less energy; if one detects this energy deficit, chemical species on the surface can be unambiguously identified at nanoscale spatial resolutions. In this work, we combine near-field vibrational spectroscopy with plasma-based synthesis of nanoparticles (Pd, Pt, and Pt alloys) to investigate reaction mechanisms on nanoscale catalytic materials.

Plasmonic coupling causes "enhanced" Raman scattering



Microplasma synthesis of catalytic nanoparticles





Enhanced vibrational signature of graphitic species on substrate surface