Title: Quantitative Determination of Particle-Size Dependent Active Sites in Supported Metal Nanoparticles with SHINERS

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Raman spectroscopy is a powerful method for solid catalyst characterization under operando conditions. However, its sensitivity often hampers the detection of surface adsorbates and reaction intermediates. Shell-isolated nanoparticle-enhanced Raman spectroscopy (SHINERS) has turned out to be a valuable addition to the catalyst characterization toolbox. SHINERS requires Au or Ag nanoparticles covered by a thin dielectric oxide coating, such as SiO_2 or Al_2O_3, to minimize plasmonic side-reactions.

In this project, we will use spark ablation technology to deposit metal nanoparticles of various sizes and chemical compositions on shell-isolated Au and Ag nanoparticles (SHINs). These metal/SHINs will allow to investigate the adsorption of probe molecules, such as NO and CO, as well as performing structure-sensitive (e.g. CO_2 and acetylene hydrogenation) and structure-insensitive (e.g. ethene hydrogenation) reactions under operando conditions.

In a second stage of the project, we will use periodically structured wafers of plasmonically active materials (i.e. Au and Ag) with well-defined Raman enhancement factors, and subsequently coat them with a non-porous SiO_2 or Al_2O_3 layer. Metal nanoparticles with variable size and composition can then be deposited on these coated wafers, thereby offering unique opportunities for performing size-dependence catalysis in a quantitative manner and under operando conditions.