Using X-Ray Absorption Spectroscopy (XAS) to gain Atomic Insight into Uniform Catalytic Materials

Andrew Riscoe[1], Cody Wrasman[1], Adam Hoffman[2], Alexey Boubnov[2], Simon Bare[2], Matteo Cargnello[1]

[1]*Chemical Engineering, Stanford University, Stanford, California 90405 (USA)*
[2]*Stanford Synchrotron Radiation Lightsource, SLAC National Accelerator Laboratory, Menlo Park, California 94025, USA*

Nearly all of the chemistry upon which humanity relies involves catalysis. Understanding the atomic nature of the catalytic active site is essential in designing more active and selective catalysts for many chemical transformations. In our group, we synthesize uniform nanomaterials and use them to derive structure-property relationships for gas-phase catalytic transformations. We use XAS characterization beamlines at SSRL to perform ex situ, in situ, and in operando XANES and EXAFS analysis on a variety of nanomaterials including metal nanoparticle-polymer hybrid systems as well as Gold-Palladium nanoparticle based catalysts. We combine this EXAFS analysis with electron microscopy and catalytic characterization to gain more insight into the fundamentals of these systems. For the metal-polymer hybrid materials we are able to track changes in the chemical nature of our catalyst during different gas treatments and with the Gold-Palladium system we have been able to determine the palladium ensemble size and track how that number evolves under reaction conditions.