Selective Chemical Transformations over Complex Heterogeneous Catalyst Surfaces

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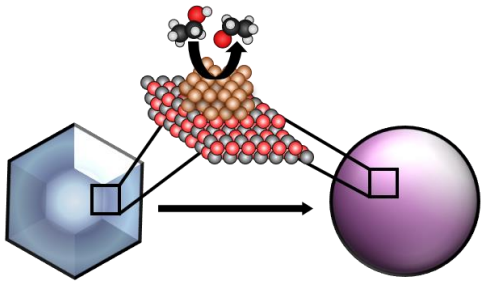
Over 90% of all manufactured goods require at least one heterogeneously catalyzed reaction step where the catalyst is in a different phase than the reactants or products. These processes often require elevated pressures and temperatures during the reaction, making it difficult to identify the active site(s). One strategy to identify catalytically relevant surface features is studying model catalyst systems using ultra-high vacuum (UHV) surface science techniques.



Schematic illustrating the structural transformation of a heterogeneous catalyst during a surface-mediated chemical transformation

Research in the Farber group leverages a combination of *in situ* UHV surface science techniques to determine the reaction mechanisms driving selective chemical transformations over model catalyst surfaces. One project focuses on understanding the specific active sites and reaction mechanism driving ethanol dehydrogenation over oxide-supported metal nanoparticle catalysts. Lewis acid sites in the oxide support are significant in the selective transformation of ethanol to acetaldehyde, but the reaction mechanism driving this transformation is not well understood. An REU student working on this project will be trained to operate the UHV experimental apparatus and use techniques such as low energy electron diffraction (LEED), Auger electron spectroscopy (AES), temperature programmed desorption (TPD), and low-temperature scanning tunneling microscopy (LT-STM). Using these techniques, they will prepare model catalyst surfaces and determine the features driving selective ethanol dehydrogenation.