Title: Visualizing Nanoscale Surface Chemistry: From Ultra-High Vacuum to Electrochemical Environments

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Abstract: Scanning tunneling microscopy (STM) is a specialized technique that can be used to examine and study nanoscale surface chemistry due to its extreme resolution. The requirement of pristine molecular resolution of certain systems necessitates the use of low temperature, ultra-high vacuum STM (LT-UHV STM) during the initial characterization of the surfaces. Importantly, it is also possible to study the assembly of molecules and atoms with liquid and electrochemical STM (EC-STM) in an attempt to bridge the temperature and pressure gap of ultra-high vacuum studies and to take measurements under more realistic conditions. In the first project, the examination of the self-assembly behavior of five amino acid molecules on a Cu(111) single crystal in UHV revealed an unexpected phenomenon. All of the amino acids assisted in the immobilization of copper atoms on the surface. These systems provide a unique glimpse into metal surface diffusion and offer the ability to study the mass transport of metal atoms. In the second project, EC-STM was used to study the deposition of Ag on Au(111), which in the presence of chloride, formed an ultra-stable layer that was stable in air and to temperatures as high as 1,000 K. Interestingly, depending on the exact potential used to form the Ag layer, a different type of thermal stability was observed. This atomically thin and ultra-stable layer which was also resistant to oxidation may find applications in a variety of fields and select anti-corrosion applications. The extension of this work in examining the impact of using different halide ions will also be discussed.