Metal clusters on alkali halide surfaces: Characterization and manipulation

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Interest in studying metal clusters of nanometer size has increased rapidly in the last decade, particularly due to the discovery of their surprising chemical activity when adsorbed on insulating substrates [1]. Important properties like adsorption site, growth, morphology and charge state of individual clusters can be characterized by noncontact AFM (nc-AFM) and Kelvin probe force microscopy (KPFM) [2]. A very important aspect is the lateral manipulation of clusters on surfaces, which permits studying the properties of clusters as a function of surface site.
In recent years we have been dealing with metal clusters on the (001) surfaces of bulk alkali halide crystals and studied their properties and manipulation characteristics by nc-AFM and KPFM in ultra-high vacuum (UHV). - Alkali halide surfaces are standard *insulating model surfaces* since they exhibit stoichiometric, almost defect-free and large atomically flat terraces providing easy access for both microscopy techniques. In particular, such model surfaces are perfect for characterizing supported molecules and metal nanoclusters. A large benefit of using alkali halide material is that it can be doped with divalent metal impurity ions like Mg^{2+} or Cd^{2+}, which leads to nanostructured (001) surfaces [3] permitting adsorption studies of molecules and clusters in dependence on surface site [4].

At the beginning of the presentation, the properties of the clean alkali halide surfaces and supported metal clusters will be briefly summarized. It will be then shown that gold clusters of nanometer size can be indeed manipulated on the surface by the AFM tip [5]. The most important characteristics of the manipulation are discussed and the manipulation mechanisms involved will be explained. At the end, an outlook is given that focuses on future applications in the manipulation of clusters. New potential substrates like thin films or nanostructured alkali halide surfaces [3] and new measurements protocols will be discussed.

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