Damping contribution in the interaction between probe and ligand-stabilized cluster in NC-AFM

G. Radu, U. Hartmann

In recent years, non-contact atomic force microscopy (NC-AFM) became a powerful tool for imaging at high resolution as well as for probing specific surface properties. In this method, the shirt of the resonant frequency of the cantilever, which serves as a frequency determining element, is used for adapting the tip-sample separation. Further atomic-scale information can be obtained by simultaneously measuring the damping of the lever oscillation due to the presence of the surface. The damping is direct related to dissipative interactions between tip and sample. In order to understand the origin of energy dissipation and to distinguish between different dissipation mechanisms, it is useful to measure the dissipation as a function of tip-sample distance (dissipation spectroscopy). A knowledge of the involved dissipation contributions provides information on atomic-scale characteristics of the respective sample. Monolayers of ligand-stabilized Au55 clusters were prepared on different substrates such as mica, HOPG, Au(111) as described in. High resolution NC-AFM images showing the individual cluster of 2 nm diameter were obtained of a particular interest is the interaction between the tip and the ligand shell (PPh3) of the clusters. Dissipative interactions are expected. Site-specific dissipation-versus-distance measurements on cluster-covered as well as uncovered areas of the substrate have been performed. An abrupt increasing of dissipation in close proximity to the surface was found in any case. There are different dependences of dissipation on the probe-sample distance on covered und uncovered areas as well as on different substrates. Exponential and power-law dependences of dissipation on the distance for mica and HOPG as mentioned in and were found. A combination of power-law and exponential dependences was found for the clusters. A model will be presented which relates the dissipation to specific properties of the ligand shell.