Study of interaction between a single nanoparticle and surfaces by the AFM

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Study of interactions between individual nanoparticles and various surfaces is of great interest for modern nanoscience. Here we report a new method to measure such interactions directly. In this method, we attach nanoparticles of to the AFM tip by gluing them with epoxy. Specifically, we demonstrate the method for 50 nm particles of ceria. Imaging the resulted tip with an inverse grid, we are able to choose the tips with a single particle at the apex, Fig.1.

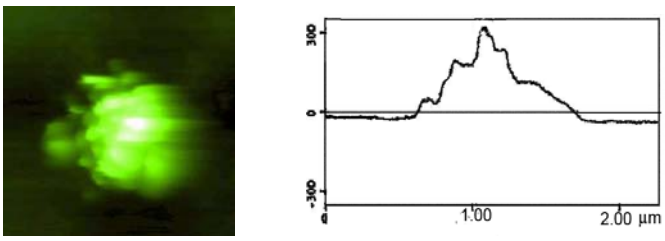

Figure 1. 2x2 μm^2 AFM image of the tip obtained with the inverted grid (left) and corresponding cross-section (right). One can find that the radius of the apex corresponds to the size of a single ceria particle.

Each modified tip was tested against clean silica wafer to test any possible traces of epoxy by comparison the measured force curves with those curves that were measured for the tip modified just with epoxy.

Using tips where each has single ceria particle at the apex, we carry out the force measurements between the single nanoparticles and various surfaces (mica, silica, polyurethane). We measure both long-range and adhesion forces in aqueous solutions of various acidity, pH 5,6,7,8, and 9.