Imaging nanometer sized metal clusters in the *constant height mode*

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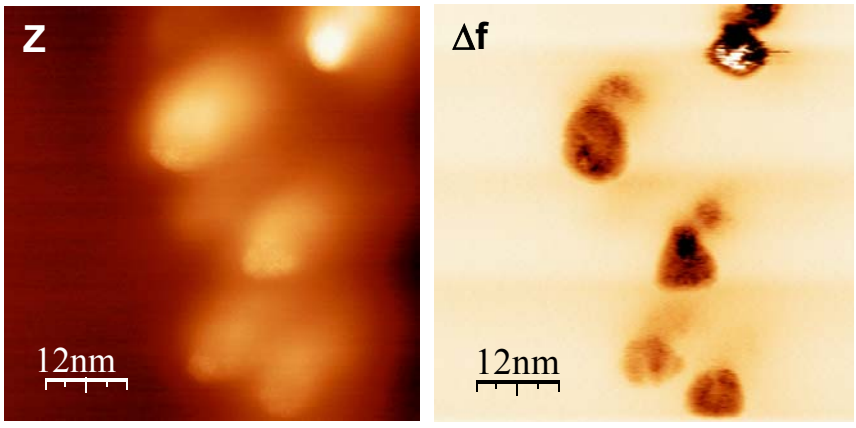
The study of metallic nanoclusters deposited on oxide surfaces forms a large domain in catalysis since these model systems provide great insight into the nature of fundamental catalytic reactions [1]. A local characterizing of the clusters concerning their nucleation, structure and electronic properties is very important and can be done in principle with scanning probe microscopy. However, work done on surfaces of insulating oxides such as MgO(001) or of insulators in general with the dynamic SFM are very rare and we recently started to study the imaging process of clusters with a dynamic SFM [2]. We noticed that in the *constant Δf mode* the tip asperity is mostly imaged as soon as its size exceeds the size of the clusters modifying size and shape of the clusters in the images [2].
In this contribution we propose to use another SFM technique for high resolution imaging of clusters which was originally introduced for atomic resolution imaging in dynamic SFM [3]. We show that it is possible to image clusters also in the *constant height mode* in which most of the image information is gathered in the detuning image Δf. We show that the image quality is higher than the one in *constant Δf mode* images and that in most cases the influence of the tip asperity can be eliminated for a large part.
We will first discuss the principle of the *constant height mode* and how the image contrast depends on scanning parameters such as loop gain, scanning speed and tip-surface distance. We then compare the *constant height mode* with the *constant Δf mode* and discuss advantages and disadvantages of both modes. Further, a comparison with TEM which yields the exact size and shape of the same clusters is given. Images taken on a variety of surfaces such as HOPG, NaCl(001), KCl(001) and MgO(001) are presented.



Images recorded in the *constant Δf mode* (left) and in the *constant height mode* (right). The images show clusters which have been created by a deposition of gold atoms on the surface of HOPG. The left image shows the topography (**Z**) and the right image the detuning (**Δf**).

[1] C. R. Henry, Surf. Sci. Rep. **31**, 231 (1998).
[2] C. Barth and C. R. Henry, Nanotechnology **15**, 1264 (2005)
[3] C. Barth, A. S. Foster, et al., J. Phys.: Condens. Matter **13**, 2061 (2001)