Dynamic Force Imaging and Spectroscopy of Individual Molecules on Thin Insulating Films

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Ultrathin insulating films on metal substrates facilitate the use of the scanning tunneling microscope (STM) to study the electronic properties of single atoms and molecules, which are electronically decoupled from the metallic substrate.

We investigated dibenzo[a,h]thianthrene adsorbed on ultrathin layers of NaCl by means of atomic force-microscopy (AFM) in a combined STM/AFM based on the qPlus-sensor [1]. We used CO-functionalized tips as has been introduced recently by Gross and co-workers [2]. The non-planar molecules exist in two stable conformations. By means of excitations from inelastic tunneling electrons we can switch between both conformations. We present atomic force microscopy (AFM) measurements with with submolecular resolution directly revealing the conformational changes [3]. From AFM data and taking the chirality of the molecules into account, we could unambiguously determine the pathway of the conformational change. Hence, the AFM channel reveals additional information that is truly complementary to the STM data set. For an even larger non-planar thiathrene derivative $C_{20}S_2H_{12}$ we also identified the structure from AFM data.

In recent studies in particular CO-functionalized tips enabled imaging with unprecedented resolution. Unfortunately, the molecular geometry appears distorted, an effect that is attributed to the bending of the CO-molecule at the tip apex in the force field of the sample. Whereas in many cases a slight distortion of the images may not affect the experimental findings, in some cases, the detailed geometric structure itself bares crucial information. We present a technique to correct for the image distortions that are due to this effect.

References

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