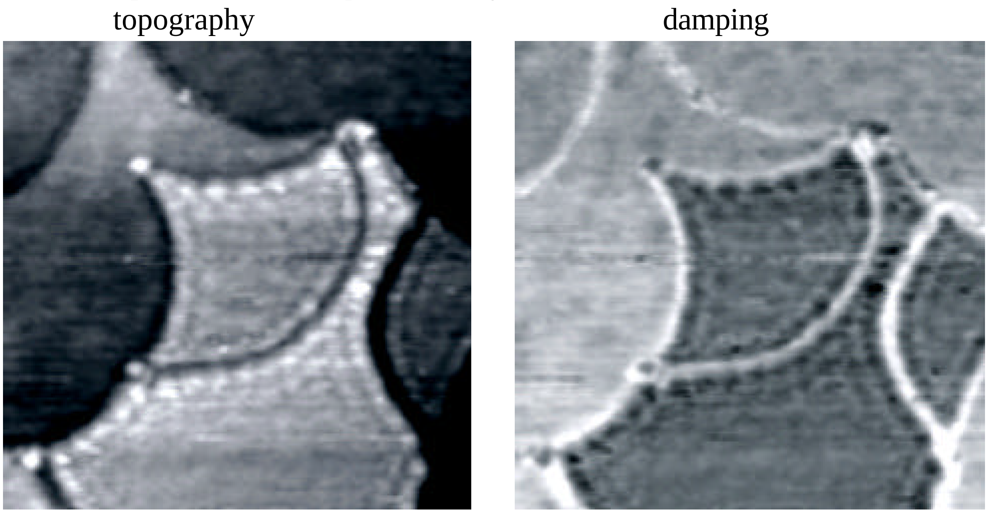
The Role of Electronic Surface States for the Energy Dissipation on Surfaces

T. Kunstmann, A. Schlarb, R. Möller
Fachbereich Physik
University of Duisburg-Essen, Germany

The (111) surface of silver has been investigated by non-contact atomic force microscopy. The interaction between the tip of the oscillating cantilever has a significant contribution by the Shockley-type electronic surface state. This is revealed by a lateral modulation which exhibits the characteristic scattering patterns of the electronic waves at step edges and other defects. The figure below shows the topography and the damping for a surface area of 225x225 nm². Beside the typical structure of a stepped Ag(111) surface oscillations can be seen in the vicinity of step edges. The observed z-signal is in phase with the local electronic density (LDOS) of the surface state i.e. the distance between the tip and the surface rises with increasing LDOS. However, the damping is lowest at the maxima of the LDOS. At low LDOS the tip approaches the surface and the interaction leads to a stronger damping. From measurements by scanning tunneling microscopy [1],[2] it is known that individual atoms adsorb preferentially at maxima of the LDOS. Our findings suggest that the tip of the cantilever is 'probing' possible adsorption sites. It should be noted that the wavelength and the decay of the oscillation do not agree with simple predictions based on the findings by photoelectron spectroscopy. It seems plausible that a model describing the interaction of the tip with the subtle equilibrium of forces at the particular surface is required to explain our results quantitatively.



NC-AFM images of Ag(111), the area is 225x225 nm²

[1] E. Wahlström, I. Ekvall, H. Olin and L. Walldén, Appl. Phys. A66 S1107(1998)
[2] J. Repp, F. Moresco, G. Meyer, K.H. Rieder, P. Hyldgaard and M. Persson, Phys. Rev. Lett. 85, 1910