Dynamic determination of κ at the atomic scale

F. Huber, A. J. Weymouth and F. J. Giessibl

Institute for Experimental and Applied Physics, University of Regensburg, 93040 Regensburg, Germany

Performing AFM with a conducting tip allows the electronic structure of the surface to be investigated. The most common technique is Kelvin Probe Force Microscopy, in which the electrostatic force between tip and sample is minimized to determine a local contact potential difference. However, with this technique, simultaneous STM is difficult, because of the varying bias potential. We propose an alternate technique [1], first introduced by the STM community [2], in which measurements of the tunnel current at the oscillating frequency of the tip can yield information about the vertical decay constant of the tunnel current, κ.

In this contribution, we describe how to measure κ with the use of a lock-in amplifier. We show atomic-scale measurements conducted on both a bare Si(111)-7×7 surface and on an Ag/Si(111) surface. We use κ to calculate the local tunneling barrier height and find, similar to previously published work [2, 3], that surface topography can play a significant role in interpreting electronic structure. Overall, we show how this additional channel can be added to any combined STM/AFM setup.

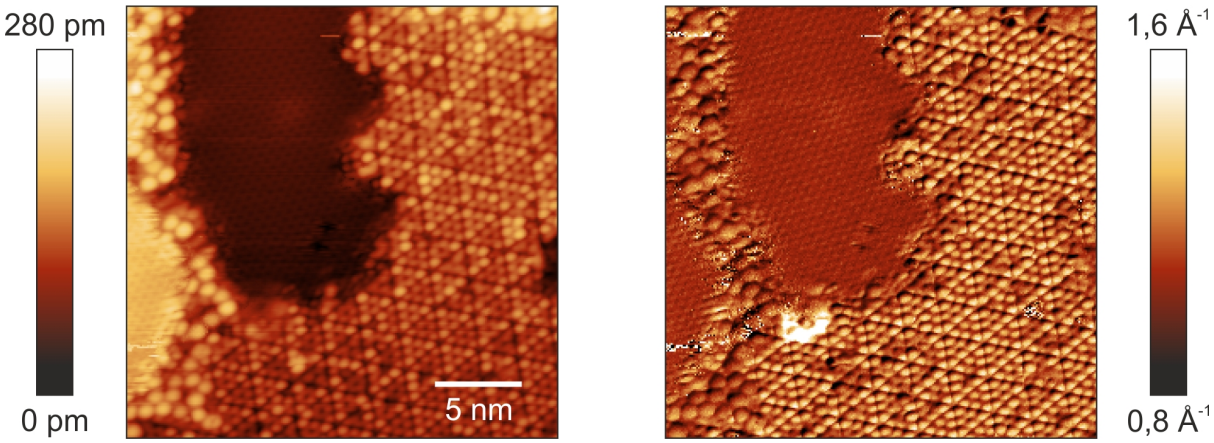

Figure: topography (left) and κ channel (right) of an Ag/Si(111) surface

References

[1] M. Herz, Ch. Schiller, F. Giessibl and J. Mannhart, Appl. Phys. Lett. **86**, 153101 (2005)
[2] G. Binnig, H. Rohrer, Surf. Sci. **126**, 236 (1983)
[3] R. Wiesendanger, *"Scanning Probe Microscopy and Spectroscopy"*, Cambridge University Press, Cambridge (1998)