

Combined Normal and Torsional NC-AFM Measurements: First Results

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Dissipative lateral forces provide the main contribution to friction. To measure these forces the tip has to move parallel to the surfaces. This can be achieved either by using the “q-plus sensor” [1], or torsional modes of a cantilever [2], [3]. In contrast to Giessibl et al. and Bennewitz et al. who used STM for tip sample distance control we use NC-AFM.

The normal and torsional modes of a commercially available cantilever have been excited simultaneously. The normal mode probes forces perpendicular to the surface while the torsional mode is sensitive to forces parallel to the surface. For our measurements we have used the frequency shift (df) of the normal mode to control the tip sample distance, giving us a topographic image of the surface. Additionally the energy dissipated in the normal mode has been recorded. The frequency shift and the damping of the lateral oscillation can be measured independently providing the conservative as well as the dissipative lateral forces.

The measurements have been carried out with the Omicron NC-AFM/STM using the Omicron SCALA electronics for the normal mode and the EASY PLL for the lateral measurements.

We obtain signals for Topography (normal), Damping (normal), df (lateral) and Damping (lateral) simultaneously. Samples for the Ag(111) surface will be shown. The amplitude of the lateral tip oscillation appears as a broadening in topographic features i.e. at step edges. Adsorbates on the surface show up in the lateral signal.

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