NANONIS APPLICATION NOTE

FRICTION FORCE MICROSCOPY

Friction force microscopy (FFM) is a powerful tool which allows us to study the origin of friction in single asperity contacts. The observation of atomic stick-slip and its variation with load, during the sliding of tip against another solid surface provides detailed information about the dissipation mechanisms. Statistical averaging of repeated measurements with good control over experimental parameters is of crucial importance for reliable FFM measurements.

Using the Nanonis SPM Controller and Programming Interface (PI) friction as a function of normal load has been measured. The PI is used to repetitively scan the same area while gradually increasing the load in successive scans, with the feedback turned on for a brief time before each scan begins. The drift in the x, y and z directions was compensated using the Atom Tracking (AT), a 2D lock-in able to detect and track local maxima in the topography. Also, the low noise of the control system and input channels allows for detection of the DC signal of the cantilever deflection with very low noise. The open nature of the Nanonis file format also allows for quick and easy analysis of large data sets.

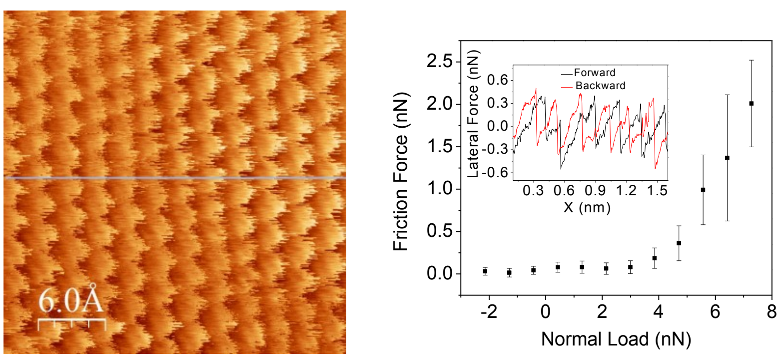

Figure 2. a) Atomic stick-slip image on Au(111) surface, b) Automatic acquisition (PI) of friction vs. load curve dependence.

The example below shows FFM image of the surface of a Au(111) film grown on mica substrate. Figure 1 shows the FFM image where the herringbone surface reconstruction on a Au(111) surface with variation in friction force less than 0.1 nN is imaged. Figure 2a shows the high resolution FFM image of Au(111) surface where the atomic stick-slip events can be clearly resolved in the lateral signal of the cantilever (inset Figure 2b). Figure 2b shows the result of automatic acquisition of friction vs. load curve.

[1] N. N. Gosvami, P. Egberts, T. Filleter and R. Bennewitz, "Microscopic Friction Studies on Metal Surfaces", Tribology Letters, (DOI 10.1007/s11249-2009-9508-5).

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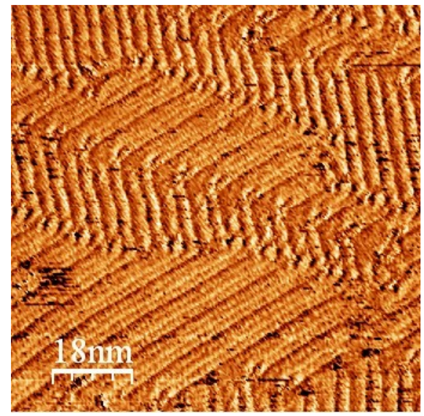

Figure 1. Friction force image of the herringbone surface reconstruction on a Au(111) substrate.

Nanonis Modules in Use:

- Base Package
- High Voltage Amplifiers
- Labview Programming Interface
- Atom Tracking Module

System:

- Home-built UHV AFM

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