

# attoSNOM III: Topography and Force Imaging

Scanning near-field optical microscopy (SNOM) has drawn considerable research interest in recent years since it allows the measurements of both the topography and the optical contrast of a sample with sub-wavelength resolution. The attoSNOM III has a piezo-based force detection sensor for scanning near-field optical microscopy applications. The probe-sample distance control works by detecting the damping of the oscillating tip as the tip approaches the sample in the nanometer range.

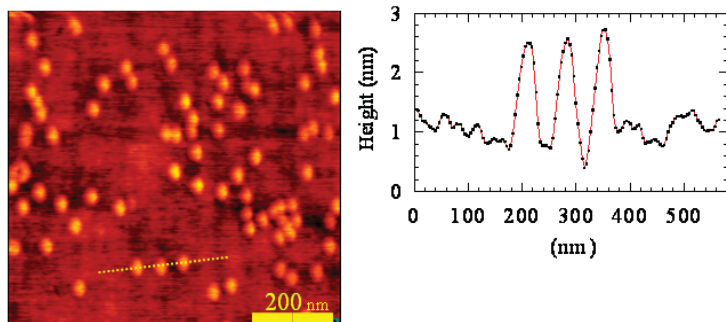
Two different detection methods can be used:

1. PI feedback loop: The force between the tip and the sample serves the input of the PI feedback electronic that keeps the force value constant and equal to a value defined by the user. A Lock-In amplifier is used to measure very small signals. Therefore, the user can plot two images: the so called "topography" (that corresponds to the piezo voltage of the z-stage) and also the phase between the dither piezo (that makes the tip vibrating) and the measured oscillation. The dephasing of these signals gives additional information.

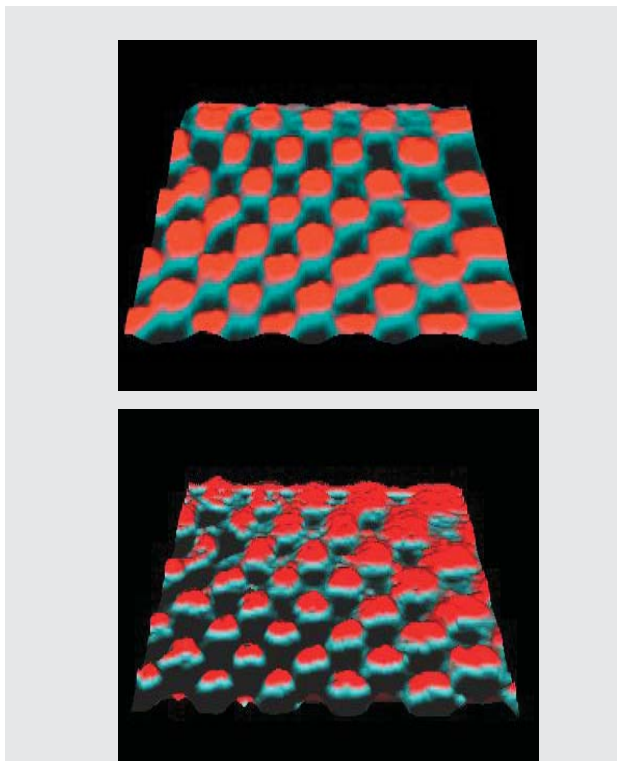
2. PLL (Phase Locked Loop): The PLL has the same functionalities as the PI electronics, but some more advantages. Unlike the PI electronics, the PLL makes the tip vibrate at its resonance frequency. During the scan, the mechanical resonance frequency of the tip changes, due to interaction forces between the tip and the sample. The PLL can either record an image that is the resonance frequency of the tip, or plot an image that corresponds to the shift of the resonance frequency due to interactions between the tip and the sample. Additional information, such as elasticity of the sample, etc... is then available.

**Related article:**

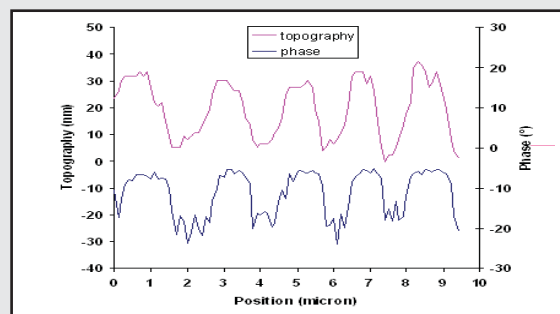
K. Karrai et al., „Interfacial Shear-Force Microscopy“, Phys. Rev B 62, (2000)



**Fig. 1:** Left: topographic image of quantum dots performed in vacuum at 4K; Right: the noise in that measurement is well below 0.1 nm.



**Fig. 1:** Topography measurement of a chess board with 2 microns in period. Top: data taken with a PI analog feedback; Bottom: phase measurement with a PLL analog feedback loop.



**Fig. 3:** Line cut of the images shown in Fig. 2.

RELATED PRODUCTS	
attoSNOM III	scanning nearfield optical microscope
ANPxyz100/LT	high precision, piezo electric, inertial positioner for big loads
ANSxy100	high precision piezoelectric scanner
ANC150/3	electronic controller
ANC200	electronic scan controller
attoSCAN	data acquisition software
attoVIEW	data viewing software