

# attoAFM I for High Resolution Imaging

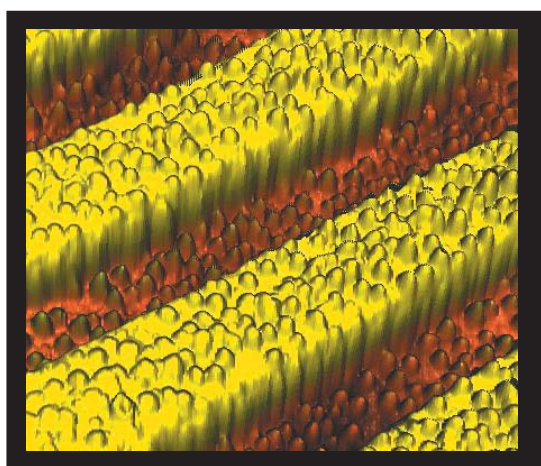


The attoAFM is an ultra-compact atomic force microscope designed for low temperature applications. The force detection scheme for the attoAFM systems is based on an all fiber low-coherence interferometer as shown in Figure 1. Monitoring the intensity of the interference fringes allows to determine the absolute value of the cantilever deflection. The precision of this measurement technique is better than  $160 \text{ fm/Hz}^{1/2}$ .

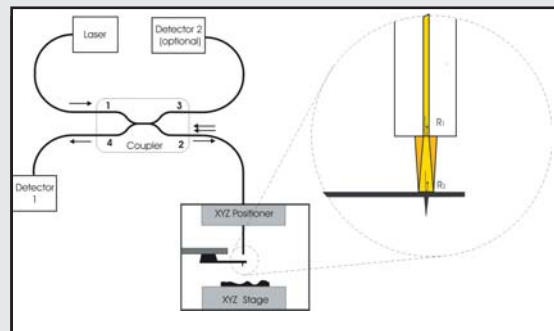
During the scan in contact mode, the cantilever is bent proportionally to the sample surface topography and the interaction forces. The fiber based optical interferometer measures the deflection of the cantilever, thus providing a topographic or force image. As an XY scanner moves the sample, the fiber based optical interferometer measures the vertical deflection indicating the local sample height. One option is to use a feedback loop (PI or PLL) that attempts to keep either the cantilever deflection, or the tip-sample force constant by adjusting the voltage applied to the z-piezo.

The resonance amplitude (and noise level) of the AFM cantilever due to thermal noise was measured using the interferometric control at a wavelength of 1330 nm. The graph is shown in Figure 2. The noise level in this experiment is well below 1 pm.

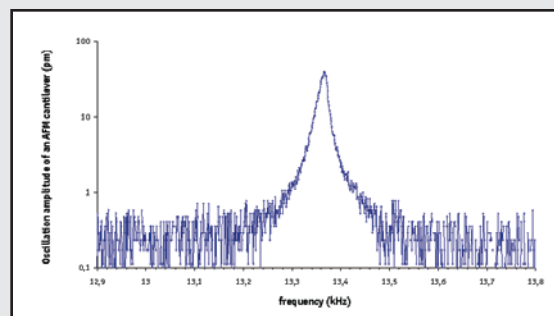
Subsequently, the attoAFM including the high precision piezo-electric scanner ANSxy100 was used to record the topography of a gold grating with 1 micron period and 10 nm height. The line scan and the image are shown in Figure 3 and Figure 4. Surface contaminations of unidentified nature with a height of approximately 1 nm could be resolved clearly. The noise in this measurement was determined to be less than 10 pm!



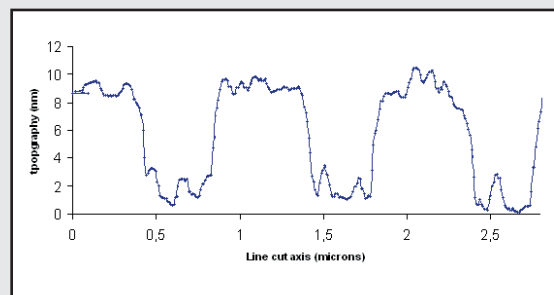
**Fig. 4:** AFM contact mode image of a gold grating with 1 micron period and 10 nm height. The contaminated surface is clearly resolved.



**Fig. 1:** Schematic representation of the AFM setup.



**Fig. 2:** Resonance amplitude (and noise level) of the AFM cantilever due to thermal noise only.



**Fig. 3:** Line cut of the AFM image acquired with the AFM II showing a height of the particles of about 1 nm. The noise was determined to be less than 10 pm.

### RELATED PRODUCTS

attoAFM	highly stable atomic force 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