

attoAFM I for High Resolution Imaging of Gold Particles

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. A picture of the AFM head is shown in Figure 2.

AFM images recorded in contact mode of gold particles (20 nm in diameter) attached to a Silicon wafer via thiolane molecules are shown in Figure 3. The single particles with a size of 20 nm are clearly resolved. The force interactions between the tip and the sample surface was observed to be quite high which can be explained by the fact that the tip slightly sticks to the coated sample surface. This is also indicated by the lines observed in Figure 3 (top). Moreover, the tip radius is in about the same range as the size of the gold particles. Thus, the experimentally determined height of the particles was 10 nm only.

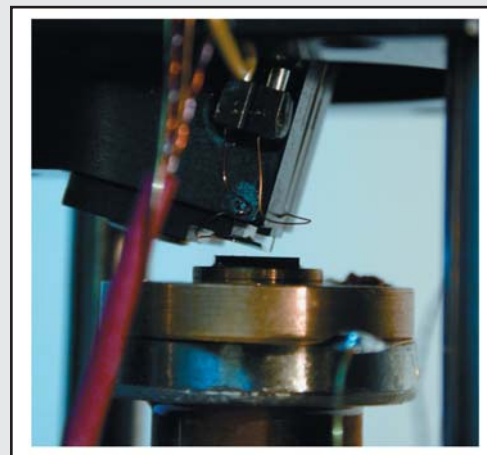


Fig. 2: Picture of the AFM head.

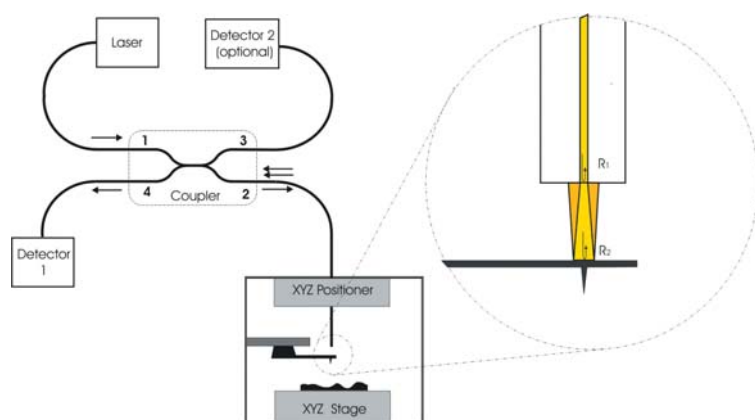


Fig. 1: Schematic drawing of the AFM setup. Insert: The small interferometer between the cantilever and the fiber end is used for the feedback control. The cantilever interface and the fiber end face form a Fabry-Perot interferometer. The precision of the cantilever deflection measurement is better than $160 \text{ fm/Hz}^{1/2}$.

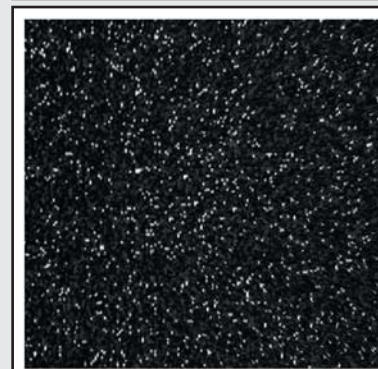
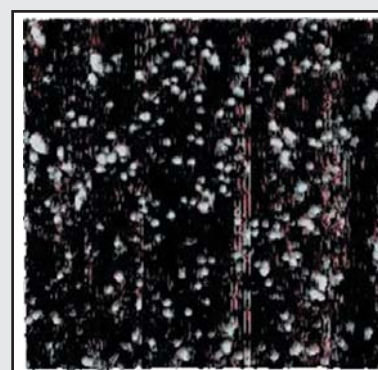


Fig. 3: AFM images of gold particles (20 nm in diameter). Top: scan range $2.5 \times 2.5 \mu\text{m}$, bottom: scan range $5 \times 5 \mu\text{m}$.

RELATED PRODUCTS

attoAFM I	highly stable and compact 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