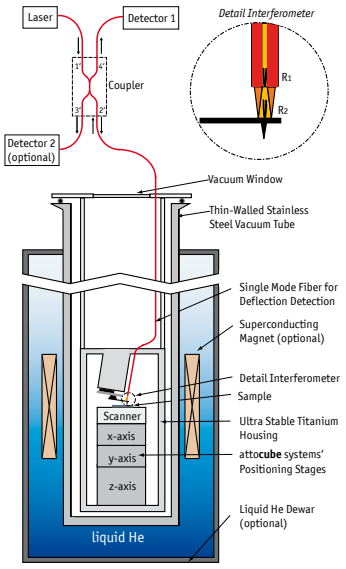
MFM Measurements on a Hard Disk sample using attocube's attoAFM I.

The flexible design of the attoAFM I represents a versatile system for high resolution force measurements. In the experiments shown here, a hard magnetic coated, commercially available AFM tip (Nanosensors) has been used to image the storage pattern of a conventional hard disk at ambient conditions.

The AFM tip was excited using a piezo at the resonance frequency of the cantilever at 75.470 kHz with an overall oscillation amplitude of ~15 nm. The phase change of the oscillation was detected and depicted in the figures on the right. The scan speed was 10 µm/s, leading to a time for one frame of approx. 12 min.

The measurements have been performed in different heights above the sample. The surface level was defined by a topography scan (not shown here) that revealed surface scratches in tangential direction of the hard disk, which roughly correspond to the x direction in the shown images.

After this calibration run, the tip was retracted by 200 nm and scanned over the sample in constant height mode. The result of this measurement is shown in Fig. 2. In a second and third measurement, the tip was scanned in 150 nm and 100 nm distance (see Fig. 3).



Scheme of the attoAFM I

In these measurements, one mainly sees two adjacent traces of magnetic information. The magnetic information is stored in vertical stripes with different magnetic orientation, while the movement of the hard disk read head was obviously perpendicular. One clearly sees that the features successively get stronger and additionally, the topography of the sample becomes more and more pronounced (one can see lateral stripes due to scratches in the surface). Indeed, the two strong defects visible in the Fig. 3 (b) are not disturbing the measurement. In Fig. 3 (a), i.e. they they exhibit a much stronger influence on the tip after it has been lowered to 100 nm distance.

In summary it has been shown that using the attoAFM I magnetic force measurements can be performed and are also highly stable. Commercially available MFM cantilevers are easily integrated and the flexible scan controller ASC500 allows the acquisition of all relevant data.

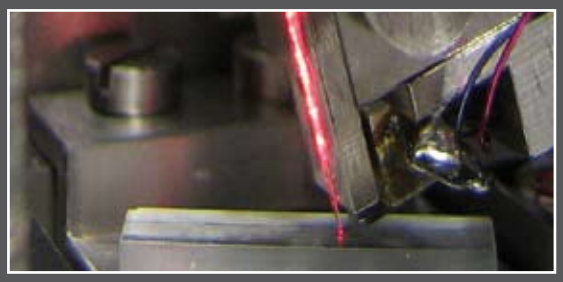


Fig. 1: CLose-up photo of the attoAFM I head showing the interferometric deflection detection on a commerical AFM cantilever.

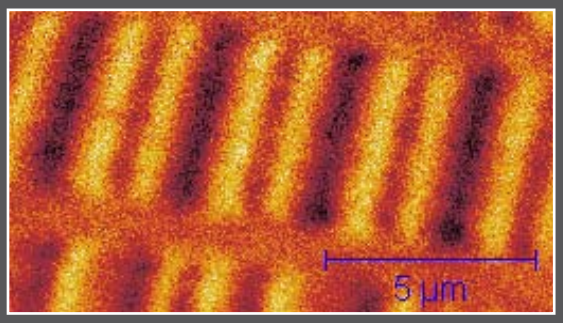


Fig. 2: Phase change of the tip oscillation due to the magnetic pattern on a piece of hard disk. The color contrast from -3° to 3° is the same for all three images. The tip was ~200 nm away from the sample.

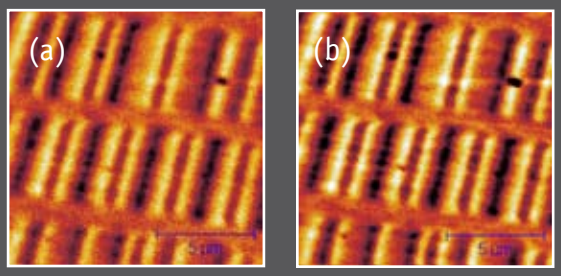


Fig. 3: Same measurement as shown above with the tip ~150 nm (a) and ~100 nm (b) away from the sample.

RELATED PRODUCTS

attoAFM I	low temperature atomic force microscope, interferometric based sensor
ANPxyz101/LT	high precision, piezo electric, inertial positioner
ANSxyz100sr/LT	xyz-scanner with high resolution z-range
ASC500	SPM controller

attocube systems
explore your nanoworld

attocube systems AG, Königinstrasse 11 A (Rgb), D-80539 München, Germany, www.attocube.com, Tel. +49 (0)89 2877 809-0, Fax. +49 (0)89 2877 809-19.