Magnetic Force Microscopy Mode

Model ID: MFM-01

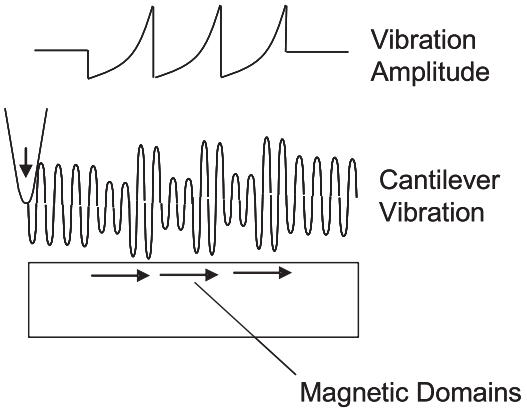
The **Magnetic Force Microscopy** (MFM) mode is an AFM technique to measure surface magnetic field by incorporating a magnetic probe into an AFM. MFM is widely used to generate images of magnetic fields associated with small domains, and is particularly useful in the development of magnetic recording technology. Magnetic fields associated with individual magnetic nanoparticles are also revealed through MFM.

In MFM mode, a sharp magnetized tip scans a magnetic sample; the tip-sample magnetic interactions are detected and used to reconstruct the magnetic structure of the sample surface. MFM probes are usually made by coating normal silicon probes with a thin magnetic coating. The most often used and sensitive method for MFM is dynamic (AC) mode, or cantilever vibration mode. AC mode oscillates the magnetically sensitive probe when it is about 5-200 nm from the sample surface. The cantilever is driven to its resonance frequency and the frequency shifts are detected.

Assuming small vibration amplitudes to a first-order approximation, the resonance frequency can be related to the natural frequency and the force gradient. That is, the shift in the resonance frequency is a result of changes in the spring constant due to the (repelling and attraction) forces acting on the tip. For attractive forces, the resonance frequency of the cantilever decreases.

In general, sample preparation is easy for MFM. No special surface preparation or coating is required. The sample does not need to be electrically conductive. Deposition of thin non-magnetic layers on the sample does not alter the results. Long-range magnetic interactions are not sensitive to surface contamination.

AFMWorkshop uses a two-pass imaging technique disclosed by A.J. Bard (1). Two separate scans of the sample are made; in the first sample scan, the topography is measured, while in the second scan, the probe is raised a specific distance above the surface and the probe follows the topography of the sample. In the second scan, magnetic fields from the surface are measured by measuring a change in phase and/or amplitude of the probe.



On the second pass of the vibrating probe over the surface, the probe is raised a fixed distance from the surface. Magnetic fields from the surface cause the vibration amplitude and phase to change. The MFM image is created by displaying the changes in amplitude and/or phase.

(1) C. Lin, F.F. Fan, A.J. Bard, High Resolution Photoelectrochemical Etching of n-GaAs with the Scanning Electrochemical and Tunneling Microscope, J. Electro. Soc. Vol 134, No 4, 1987, p 1038

MFM OPTION INCLUDES

* Field imaging software
* Magnetic probes
* Magnetic test sample
* Magnetizer
* Non-magnetic sample holder
* MFM User Guide
* EBox Control Circuit

SPECIFICATIONS

MFM Probe Model: **MagneticMulti75-G**

Substrate Dimensions:
3.4mm x 1.6 mm x 0.3 mm

Length: **225 µm**

Width: **28 µm**

Thickness: **3 µm**

Tip Height: **17 µm**

Tip Set Back: **15 µm**

Tip Radius: **< 60nm**

Force Constant: **3N/m**

Resonant Frequency: **75KHz**

COATING:

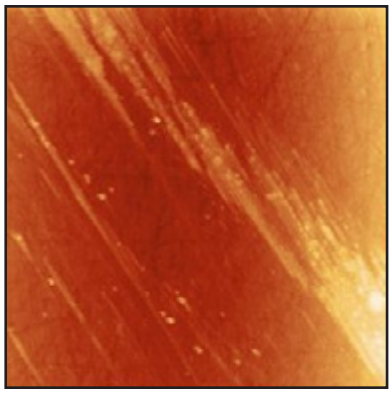
Tip side: **Magnetic**

Detector side: **Aluminum**

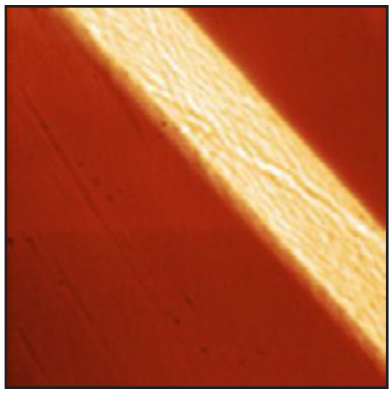
SOFTWARE CONTROL PARAMETERS

* AFMControl parameters for vibrating mode
* Display and save MFM Phase or MFM Amplitude
* Tip raise control
* Tip raise rate control
* Tip drop down rate control
* Inter Scan delay control
* Field Amplitude control

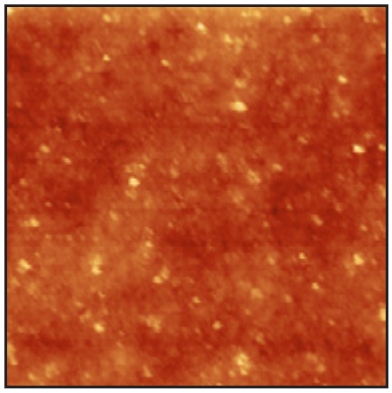
MFM Application Images



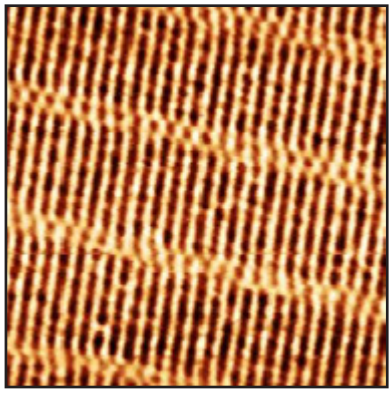
AFM image, Magnetic Read/ Write Head 40 X 40 µm



MFM image, Magnetic Read/ Write Head 40 x 40 µm



AFM image, Zip Disk 40 x 40 µm



MFM image, Zip Disk 40 x 40 µm