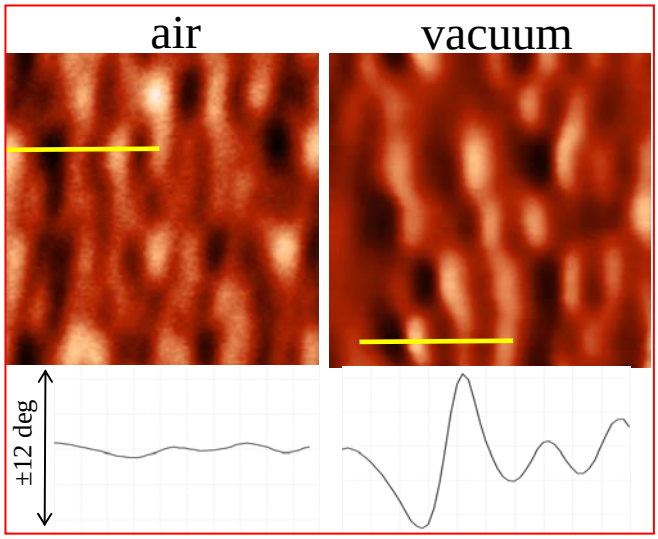
# Six essentials of high-quality MFM

1. Increased sensitivity due to vacuum environment
2. Increased sensitivity due to electronics design
3. Accurate external field application
4. Scanner with no magnetic parts (external field does not obstruct imaging)
5. Multi-pass compensation of electrostatic and other influences
6. Precise temperature changing during MFM measurements

1




## Even low vacuum substantially increases signal-to-noise ratio

MFM images of hard disk surface obtained in ambient air and in vacuum. Signal-to-noise ratio of phase imaging is more than ten times better even at $10^{-2}$ torr as shown on line profiles. Both images are 1x1 μm.

2

## Very weak signal can be detected

Phase detector sensitivity is as high as 0.04° - thus very low phase shift can be detected. In addition, there are two ways the signal can be further amplified by electronics.

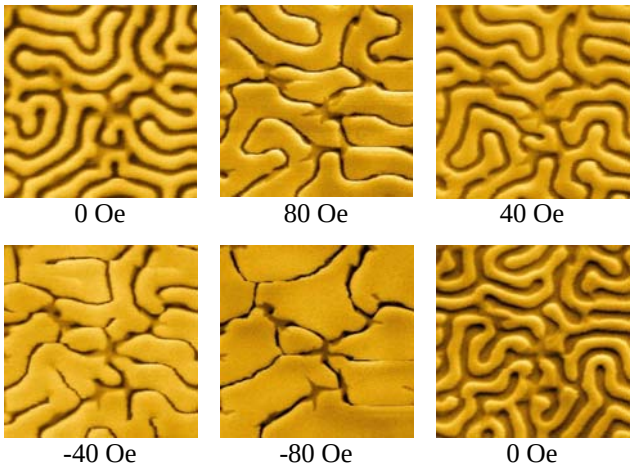
## Moreover it can be electronically amplified

First, the amplification can be set to occur in the phase detector itself. Second, the mag*sin(t) signal (depending on both oscillation amplitude and phase) can be amplified by the synchronous detector. This channel is often much more sensitive than the phase itself and this way even very weak magnetization can be imaged and measured.

3

## External field can also be applied in vertical direction

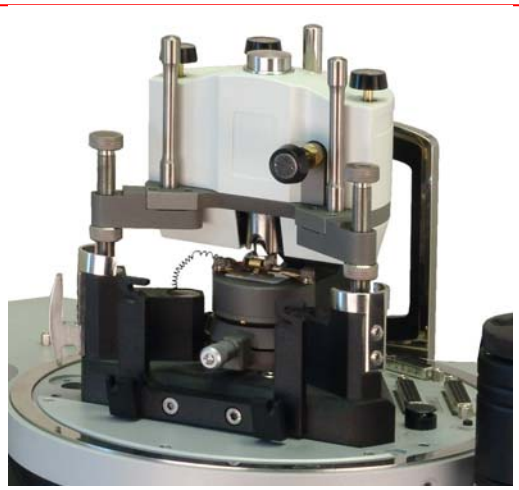
Sequential images of ferrite garnet film in the presence of vertical external field. Images are from the same area, 90x90 μm. Sample courtesy of Prof. F.V. Lisovskiy, Institute of Radioengineering & Electronics RAS, Russia.



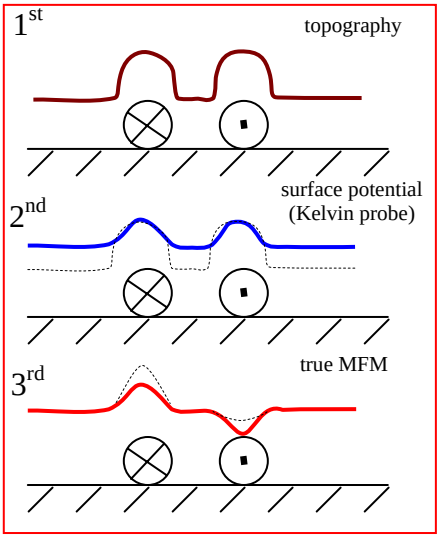
4

## Scanner is free of magnetic parts

External field does not obstruct the imaging process (even when the field is switched on and off) because within the scanner there are no magnetic parts that interact with the field. The scanning head is now equipped with the CL sensors, thus even more precise imaging can be performed.



5




Coming soon

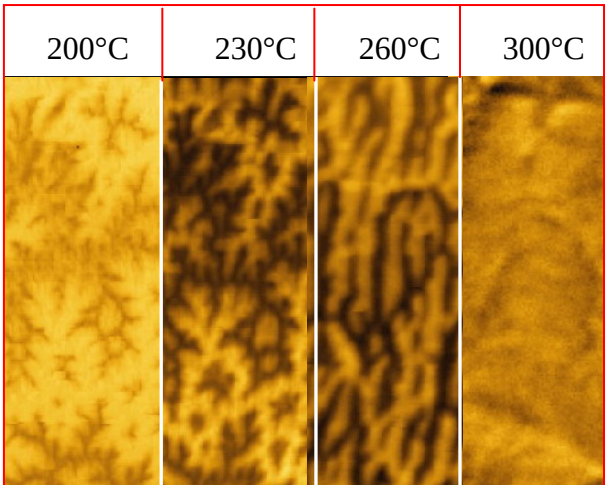
## Compensation of electrostatic and topography influence

For samples possessing any electrostatic potential several passes should be performed in one session. The experiment with magnetization of a nanoelectronic element is conducted as follows:
1st pass shows topography;
2nd pass shows surface potential with topography influence compensated;
3rd pass shows magnetization with both electrostatic potential and topography compensated.

6

## Sample temperature can be changed during MFM

MFM images of cobalt monocrystal with uniaxial anisotropy. Phase transition occurs when temperature increases. Images obtained from the same area, 14x40 µm. Sample courtesy of Prof. A.G. Pastushenkov, Tver University, Russia.



| | | |
|---|---|---|
| **MFM on the NTEGRA platform** | | |
| Vacuum | | $10^{-2}$ torr |
| Temperature | | RT to +150°C |
| External field | in-plane<br>vertical | +/- 0.2 T<br>+/- 0.05 T |
| **MFM in high vacuum** | | |
| Vacuum | | $10^{-6}$ torr |
| Temperature | | 110K to 420K |
| External field | in-plane | +/- 0.1 T |

# Enjoy the highest quality MFM!


**Nano Technology Instruments – Europe B.V.**
Arnhemseweg 34 d, NL 7331 BL Apeldoorn,
the Netherlands
tel: +31-(0)55-5402565,
fax: +31-(0)55-5402566

**Nanotech-America, Inc.**
313 South Jupiter Rd, Suite 105
Allen, Tx 75002
tel.: 972-954-8014, 781-545-6811,
fax: 972-954-8018