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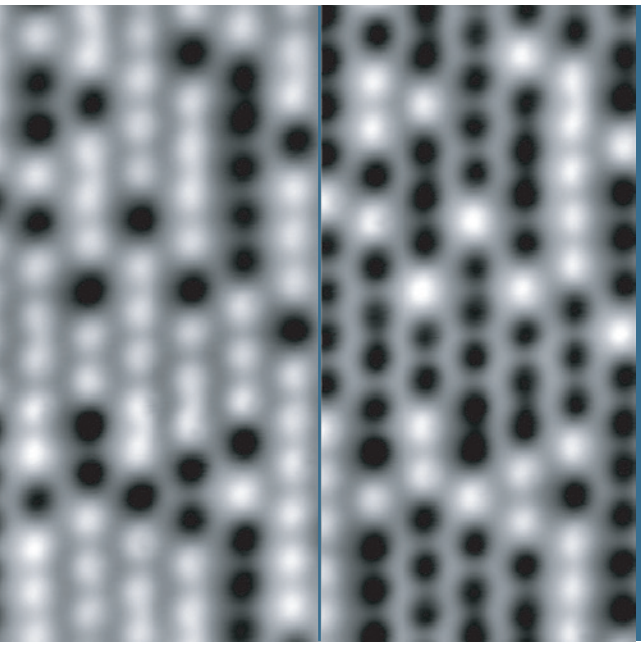
In-Situ Switching of Tip Magnetization



NanoScan VLS-80

Ruling out topographic effects in Magnetic Force Microscopy (MFM) measurements is a key issue. Switching the magnetization of the tip is one tool to distinguish between topography and magnetism.

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In-Situ Switching of Tip Magnetization

The tip magnetization can be switched with a well-defined magnetic field without breaking vacuum

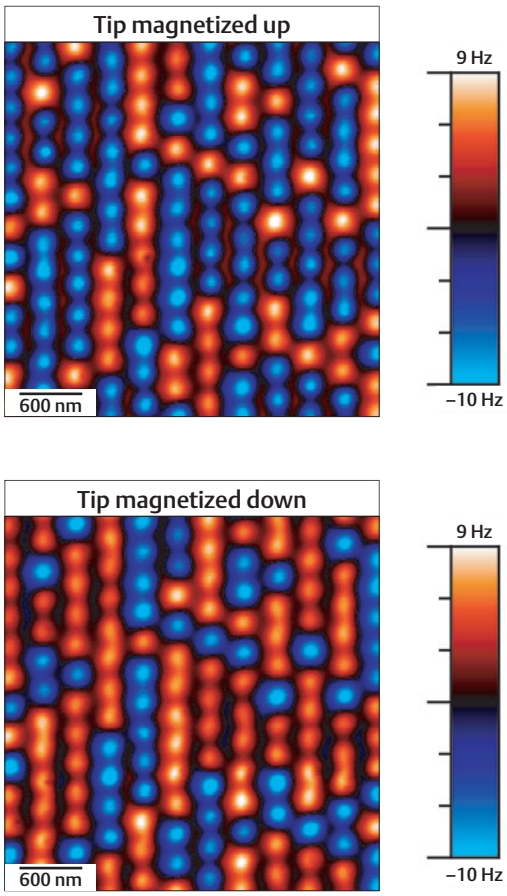
The NanoScan VLS-80 microscope features built-in permanent magnets over which the tip can be positioned with high accuracy to switch its magnetization. This is done without influencing the sample and without breaking vacuum. The permanent magnets are positioned to avoid any interference with samples.

The switching of the tip magnetization is software-controlled and takes just seconds. The tip returns to the imaging area with an accuracy better than 1 micron.

The right-hand figure shows MFM data of bit-patterned media with a pitch of 200 nm which exhibits perpendicular magnetic anisotropy. The two images show the magnetization of the islands before and after switching the tip magnetization. The contrast of all islands is inverted, proving that the signal is magnetic and topographic contributions can be ruled out.

The measurement mode is high-resolution magnetic force microscopy, a non-contact form of MFM. The contrast seen in the image represents the frequency shift of the cantiliever resonance as a result of the interaction between the tip and sample magnetic stray fields.

Further, during the switching process the height of the tip is accurately defined by a linear encoder. This allows well-defined magnetic fields of both polarity to be applied to the tip.



hr-MFM images of bit-patterned media with a pitch of 200 nm. The upper image shows the magnetic signal with tip magnetized up and the lower image shows the same area after switching the direction of the tip magnetization. Red/blue contrast refers to the tip and sample magnetization being anti-parallel/parallel.

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