Manipulating magnetism at the nanoscale

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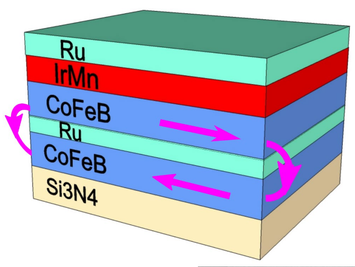
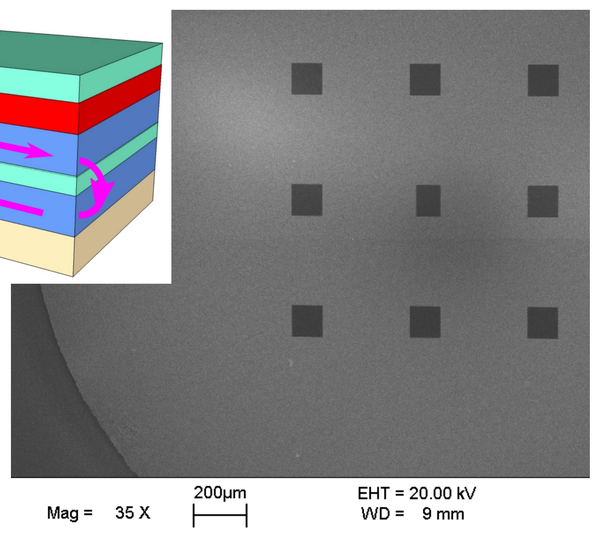
The search for novel tools for controlling the physical properties of matter at the nanoscale is crucial for the development of new paradigms in optics, electronics and spintronics. We use thermally assisted scanning probe lithography (tam-SPL) for manipulating the structural and magnetic phase of thin film materials, and control static and dynamic magnetic properties of thin films at the nanoscale.

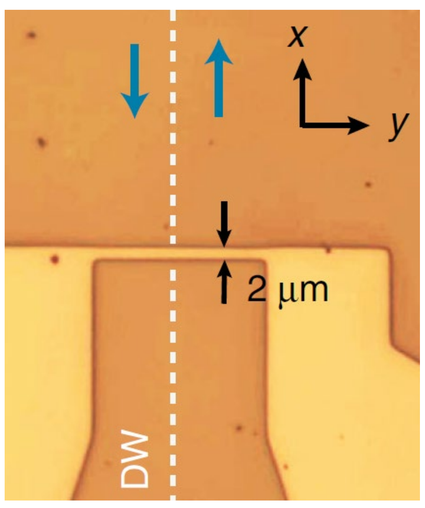
Sample growth and nanofabrication

> Sample growth on Si/SiN membranes is performed via a AJA ATC Orion8 sputtering system

> Micro and nano-fabrication is carried out via optical/laser beam/electron beam lithography



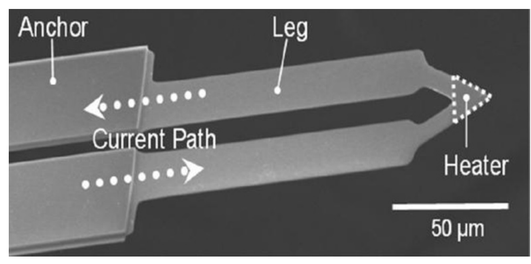




Thermal nanolithography

> Swisslitho NanoFrazor Explore system used for thermal nanolithograhpy

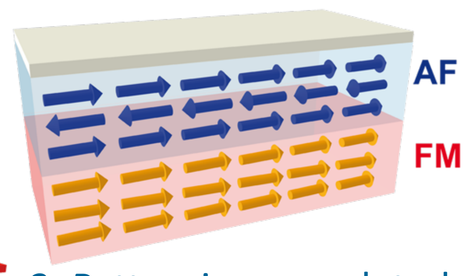
> SEM image of a thermal cantilever used for tam-SPL. The heating current runs in the 2 conductive arms



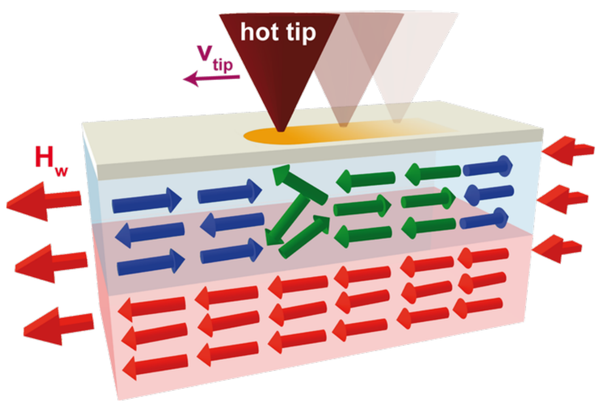
Thermally assisted *magnetic* scanning probe lithography

Concept

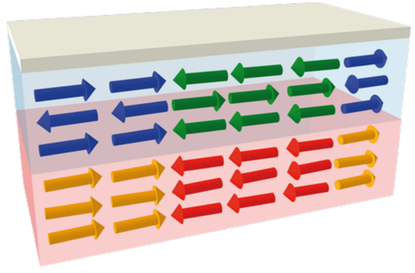
1. Exchange bias is initialized via uniform field cooling.



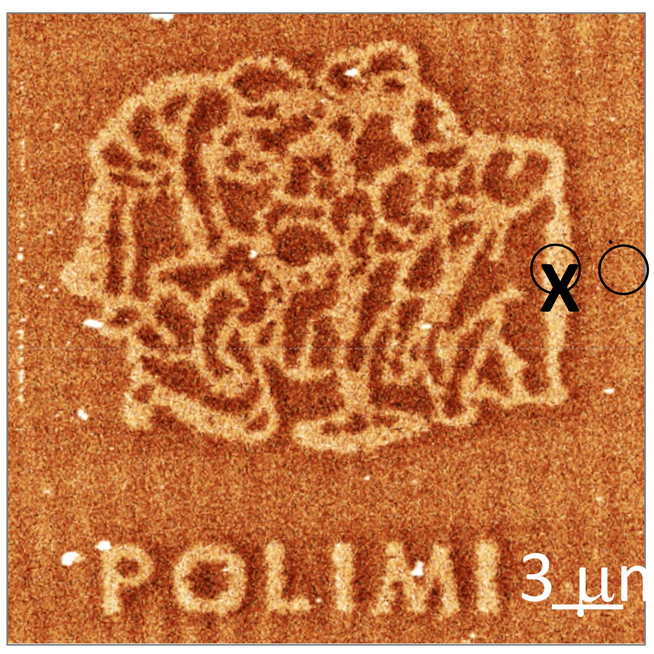
2. *tam*-SPL: magnetic field + hot tip scan.

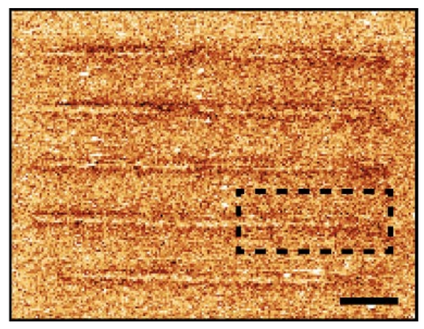


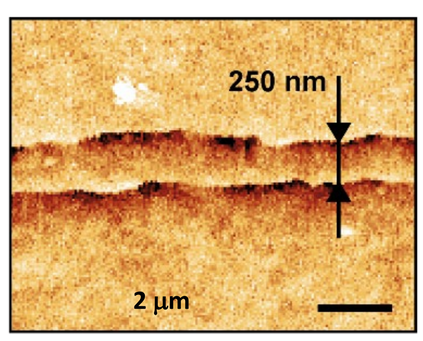
3. Patterning completed: magnetic field is removed.



> Stabilization of 2D magnetic domains and 1D domain walls and 0D topological solitons via tam-SPL. Below, magnetic force microscopy images of the magnetic domains and domain walls.

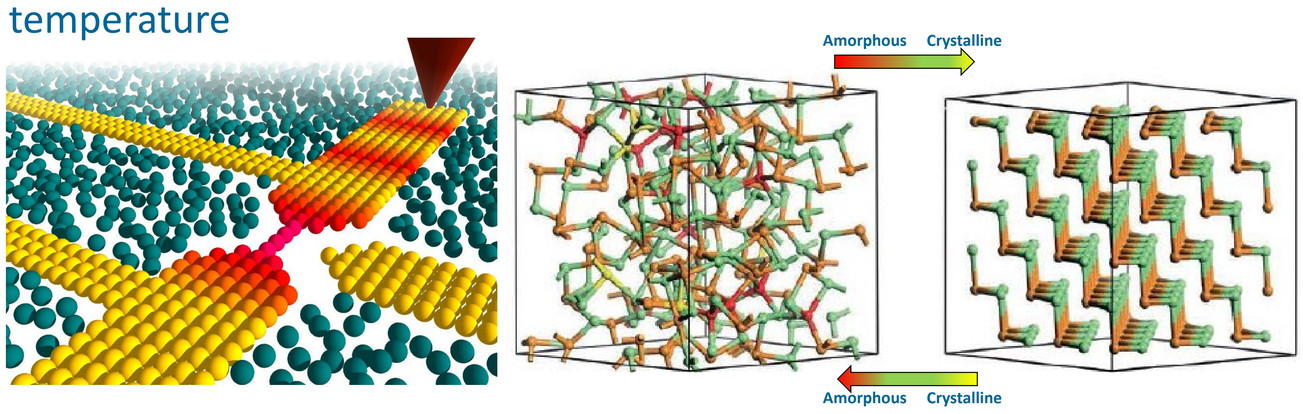




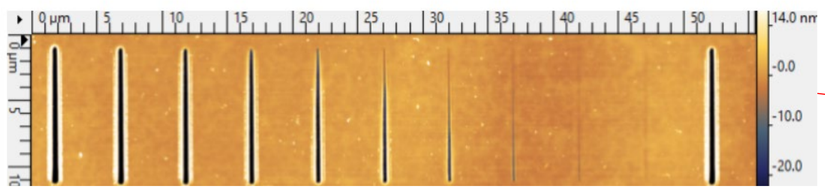


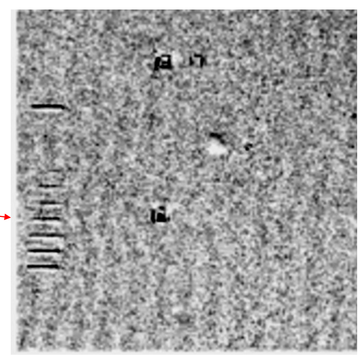
«Phase-nanoengineering» in crystals and PCM

> Manipulation of the physical properties of crystals and phase-change materials at the nanoscale with t-SPL, tuning locally and reversibly their electrical and optical properties as a function of the patterning temperature



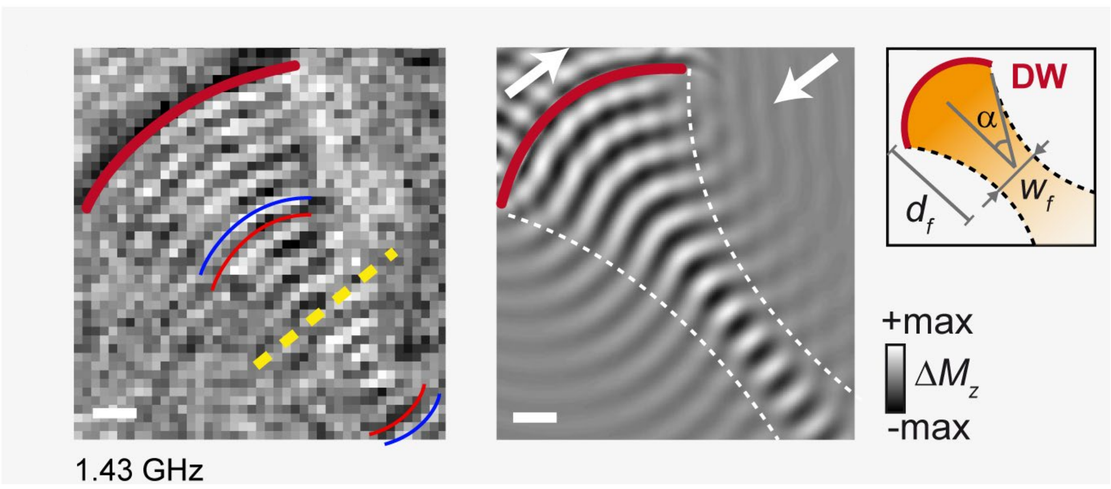
> µ-MOKE images of the patterned lines as pinning points for the stabilization of magnetic domains



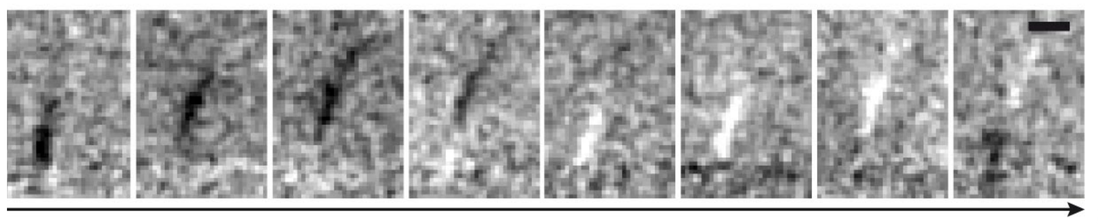


Controlling spin-waves at the nanoscale

> Spin-textures as «magnonic nanoantennas» for shaping spin-wave wavefronts and generating tailored interference patterns



> Patterned straight and curved domain walls as magnonic waveguides



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