Thermal scanning probe lithography for nanoscale magnetic domain switching

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Thermal scanning probe lithography (t-SPL) uses a heatable ultra-sharp tip for nanoscale physical or thermal modification and simultaneous imaging of materials. The technology has proven its value as an enabler of new kinds of ultra-high resolution nanodevices as well as for improving the performance of existing device concepts [1]. The range of applications for t-SPL is very broad including ultra-high resolution 2D and 3D patterning. Nanometer-precise markerless overlay and non-invasiveness to sensitive materials are among the key strengths of the technology. In addition, an integrated laser write head has been introduced to increase the throughput of lower resolution patterning and to enable the fabrication of systems where feature sizes range from nanometers to millimeters [2].

Recently, t-SPL has been used to define nanoscale magnetic domains into arbitrary shapes and directions of magnetization by locally heating multilayer ferromagnetic/antiferromagnetic thin film stacks under an external magnetic field [3]. Accurate control over individual domain walls enables the creation of, e.g. vortex/antivortex pairs and Bloch lines, guiding spin waves and defining versatile, optics-inspired magnonic circuits for spin waves demonstrating engineered wavefronts, focusing and robust interference with nanoscale wavelength. [4]

In this poster, we demonstrate the abilities of thermal scanning probe lithography not only as a high-resolution nanolithography tool that can replace or complement electron beam lithography in challenging applications, but also as a versatile instrument for studying magnetic phenomena at the nanoscale.

References:

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