Fabrication of a micro-fluidic device with integrated hard magnetic micro-flux sources for particle manipulation

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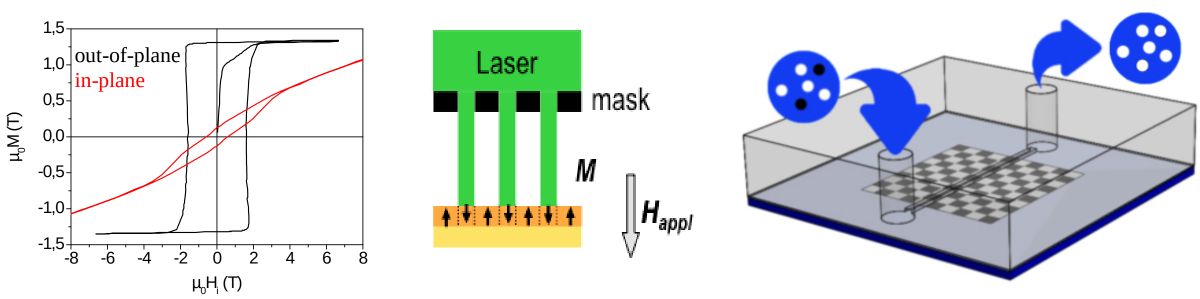
Magnetophoresis refers to the motion of an object under the influence of an inhomogenous magnetic field and is exploited for the manipulation (trapping, separation, mixing. transportation…) of biological species [1]. As the magnetic field or "flux" source, hard magnetic material based structures have the advantage of being autonomous, requiring neither a power supply (c.f. coil based structures) nor an external magnetic field source (c.f. soft magnetic material based structures). The magnetophoretic force on an object, given by $F_m = Mv\nabla B$ (v is the volume and M the magnetization of the object), may be maximized by increasing the field gradient (∇B), through a reduction in the size of the flux source. Thus the interest of exploiting magnetophoresis at the micro-scale.

- The first part (4h) of the practical is dedicated to the fabrication of thick hard magnetic NdFeB films by high rate triode sputtering [2], their micro-patterning using the Thermo-Magnetic-Patterning (TMP) technique [3], and their characterization.
- The second part (5h) of the practical is dedicated to the fabrication of polymer-based micro-fluidic channels, their integration above micro-patterned hard magnetic films and the separation of magnetic and non-magnetic micro-particles in the micro-fluidic device [4].



Left: Hysteresis loops of a 5 μm thick NdFeB film; **centre:** local patterning of a hard magnetic film using the TMP technique; **right**: PDMS μ-fluidic device with integrated μ-magnets for particle manipulation.

[1] M.A.M. Gijs, F Lacharme, and U. Lehmann, *Chem. Rev*. 2010**, 110**, 1518

[2] N.M. Dempsey, A. Walther, F. May et al., *Appl. Phys. Lett.* 2007, **90** 092509

[3] F. Dumas-Bouchiat, L.F. Zanini, M. Kustov, et al., *Appl. Phys. Lett.*, 2010, **96**, 102511

[4] L.F. Zanini, N.M. Dempsey, D. Givord, et al., *Appl. Phys. Lett.*, 2011, **99**, 232504