XMCD-PEEM monitoring of the field-induced controlled switching of Neel caps in magnetic flux-closure dots

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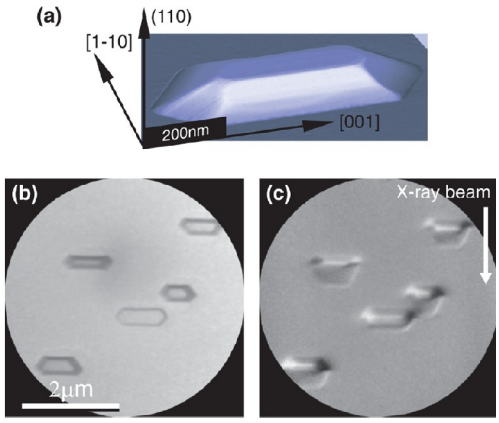
An increasing number of studies focus on magnetic domain walls (DW's) as objects that can be moved by a magnetic field or a spin-polarized current. The few reports on the manipulation of the internal configuration of DW's or vortices in nanostructures concern the reversal of vortex cores in circular permalloy dots. These studies proved that two degrees of freedom can be manipulated independently in the so-called vortex state: 1. the in-plane chirality of magnetization; 2. the perpendicular polarization of the vortex core. We have been one step further and demonstrated the manipulation of a third degree of freedom in a flux-closure state. We could switch the direction of magnetization of Néel caps (NC's) occurring atop and below the Bloch wall in elongated dots. Micron-sized self-assembled Fe(110) dots grown by Pulsed Laser Deposition under UHV have been used as a model system for this purpose. The switching process was thoroughly monitored by X-ray Magnetic Circular Dichroism PhotoEmission Electron Microscopy (XMCD-PEEM), and supported by micromagnetic simulations. The complementarity with other magnetic microscopies such as MFM and Lorentz microscopy will be outlined.



Typical (a) AFM, (b) LEEM and (c) XMCD-PEEM views of self-assembled Fe(110) dots. In (c) the top Néel caps appear as a thin line along the dot, here all aligned along the same direction (appearing white) following a magnetization procedure.

References

[1] F. Cheynis, N. Rougemaille, R. Belkhou, J.-C. Toussaint, O. Fruchart, *X-ray photoelectron emission microscopy in combination with x-ray magnetic circular dichroism investigation of size effects on field-induced Néel-cap reversal*, J. Appl. Phys. **103**, 07D915 (2008).

[2] F. Cheynis, A. Masseboeuf, O. Fruchart, N. Rougemaille, J. C. Toussaint, R. Belkhou, P. Bayle-Guillemaud, A. Marty, *Controlled Switching of Néel Caps in Flux-Closure Magnetic Dots*, Phys. Rev. Lett. **102**, 107201 (2009).

[3] A. Masseboeuf, O. Fruchart, J. C. Toussaint, E. Kritsikis, L. Buda-Prejbeanu, F. Cheynis, P. Bayle-Guillemaud, A. Marty, *Dimensionality cross-over in magnetism: from domain walls (2D) to vortices (1D)*, Phys. Rev. Lett. **104**, 127204 (2010).

[4] O. Fruchart, N. Rougemaille, J. C. Toussaint, R. Belkhou, Y. Tian, H. Yu, F. Cheynis, A. Masseboeuf, P. Bayle-Guillemaud, A. Marty, *Asymmetric hysteresis of Néel caps in flux-closure magnetic dots*, IEEE Trans. Magn. MAG. **in press**.

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