Tuning Topological Defects in Magnetic Stripe Domains of Lateral Multilayers with Perpendicular Magnetic Anisotropy

A. Hierro-Rodríguez[1,2], M. Vélez[1], J. I. Martín[1,2,*], R. Cid[1,2], G. Rodríguez-Rodríguez[1,2], J. M. Teixeira[3], G. N. Kakazei[3,4], J. B. Sousa[3], R. Morales[5,6], N. Soriano[7], L. M. Álvarez-Prado[1,2], J. M. Alameda[1,2]

[1]*Depto. Física, Universidad de Oviedo, 33007 Oviedo, Spain*
[2]*CINN (CSIC - Universidad de Oviedo - Principado de Asturias), Llanera, Asturias, Spain*
[3]*IN-IFIMUP, Depto. Física e Astronomia, Universidade do Porto, 4169-007 Porto, Portugal*
[4]*Institute of Magnetism NAS of Ukranie, 03142 Kiev, Ukraine*
[5]*Depto. Química-Física & BCMaterials, Universidad del País Vasco-UPV/EHU, 48940 Leioa, Spain*
[6]*IKERBASQUE, Basque Foundation for Science, 48011 Bilbao, Spain*
[7] *Depto. Química-Física, Universidad del País Vasco-UPV/EHU, 48940 Leioa, Spain*

Amorphous Nd-Co films with weak perpendicular magnetic anisotropy have been nanostructured with a periodic thickness modulation that results in the modulation of both stripe domain periods and in-plane magnetization component. The resulting system is the 2D equivalent of a strained superlattice with properties controlled by interfacial misfit strain within the magnetic stripe structure and shape anisotropy. Magnetic force microscopy measurements reveal that, depending on lateral multilayer period and in-plane applied field, it is actually possible to tune the magnetization reversal process and to control the nucleation of topological defects within the magnetic stripe domain pattern. In particular, for large enough periods, thin and thick regions switch independently during in-plane magnetization reversal and domain walls are created within the in-plane magnetization configuration coupled to variable angle grain boundaries and disclinations within the magnetic stripe domain patterns.

The process is mainly driven by the competition between rotatable anisotropy (that couples the magnetic stripe pattern to in-plane magnetization) and in-plane shape anisotropy induced by the periodic thickness modulation. However, as the structural period becomes comparable to magnetic stripe period, the nucleation of topological defects at the interfaces between thin and thick regions is hindered by a size effect and stripe domains in the different thickness regions become strongly coupled.

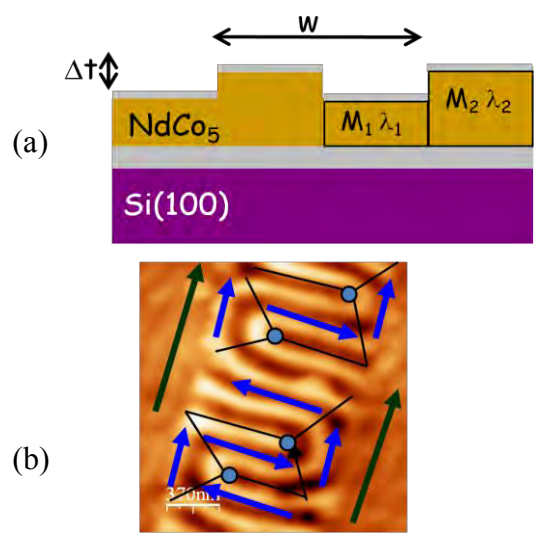

Fig 1. (a) Sketch of Lateral Magnetic Multilayer; (b) Topological defects in the stripe domain pattern of a NdCo lateral multilayer (1/2 disclinations coupled to 1/2 vortices).

[1] A. Hierro-Rodríguez, R. Cid, M. Vélez, G. Rodríguez-Rodríguez, J. I. Martín, L. M. Álvarez-Prado, and J. M. Alameda, Physical Review Letters **109**, 117202 (2012)
[2] A. Hierro-Rodriguez, G. Rodríguez-Rodríguez, J. M. Teixeira, G. N. Kakazei, J. B. Sousa, M. Vélez, J.I. Martín, L. M. Álvarez-Prado, and J. M. Alameda, J. Phys. D **46**, 345001 (2013)
[3] A. Hierro-Rodríguez, M. Vélez, R. Morales, N. Soriano, G. Rodríguez-Rodríguez, L. M. Álvarez-Prado, J. I. Martín, and J. M. Alameda, Physical Review B (en prensa)