Magnetization reversal in exchange coupled IrMn/FeCo patterned lines

I. Montoya[1], L.E. Fernandez-Outon[2,3], C. Redondo[1], W. A. A. Macedo[3], R. Morales[4,5]

[1]Dpto. Química-Física, Universidad del País Vasco UPV/EHU, 48940 Leioa, Spain.
[2]Departamento de Física, Universidade Federal de Minas Gerais, Belo Horizonte, 31270-901, Minas Gerais, Brazil
[3]Centro de Desenvolvimento da Tecnologia Nuclear, 30123-970 Belo Horizonte, Minais Gerais, Brazil.
[4]Dpto. Química-Física & BCMaterials, Universidad del País Vasco UPV/EHU, 48940 Leioa, Spain.
[5]IKERBASQUE, Basque Foundation for Science, 48011 Bilbao, Spain.
Contact e-mail: isaac.montoya@ehu.eus

Exchange bias phenomenon arises from the interfacial coupling at antiferromagnetic/ferromagnetic (AFM/FM) interfaces and manifests as a unidirectional anisotropy on the FM, yielding a shift of the center of the hysteresis loop along the field axis known as exchange bias field (H_{EB}). The magnitude of the H_{EB} depends on the cooling procedure below the AFM Néel temperature. On the other hand, patterning of AFM/FM bilayers can modify the magnetic properties of materials inducing competing anisotropies. [1,2]

This work investigates the magnetization reversal of sputter-deposited polycrystalline IrMn/FeCo (AFM/FM) bilayers. In plane magnetization curves were measured at several angles by VSM magnetometry before and after an external field annealing for patterned and non-patterned bilayers. IrMn/FeCo lines were fabricated by physical etching of continous bilayers. The external magnetic field during annealing was applied parallel to the line axis.

The in plane angular dependence of hysteresis loops does not show any preferential anisotropy axis in as-grown samples, neither for non-patterned bilayers nor for patterned lines. The annealing of patterned and non-patterned samples originates exchange bias at room temperature. This procedure sets a clear unidirectional and uniaxial anisotropy along the external field direction, with a strong H_{EB} parallel to the line axis and null remanence and H_{EB} in the direction perpendicular to the lines. Magnetization reversal at different angular orientations is compared for patterned and unpatterned materials.

This work was supported by grants: EU FP7-IRSES-318901, Spanish MINECO FIS2013-45469 and FIS2016-76058, and CNEN, Fapemig, Capes, CNPq.

References

[1] J. Nogués, J. Sort, V. Langlais, V. Skumryev, S. Suriñach, J.S. Muñoz, M.D. Baró, Physics Reports 3(2005) 65-117.
[2] Z.P. Li, R. Morales, I.K. Schuller, Appl. Phys. Lett., 94(2009) 142503

Figures

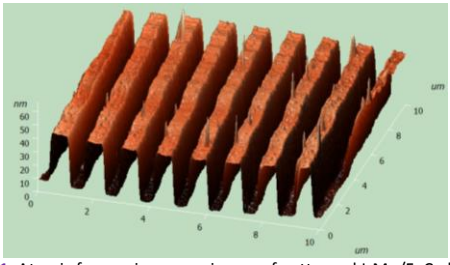

Figure 1: Atomic force microscopy image of patterned IrMn/FeCo bilayer.