Magnetization reversal of epitaxial nanodots: MFM studies and micromagnetic simulations

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In this work we investigate magnetization reversal process in nanodots. The dots are formed by the part of the Co layer which is deposited on the top of Au islands self-assembled on the Mo layer surface. Due to a strong dependence of magnetic anisotropy on a type of the interface, the magnetic properties of the matrix, i.e. that part of the Co layer which is grown on the Mo layer surface between the Au islands, are substantially different from the dots. Depending on the Co layer thickness the perpendicularly magnetized dots are embedded in the matrix with magnetization either aligned perpendicularly or in the sample plane [1].

Magnetic states and magnetization reversal of the dots were investigated by polar magnetooptical Kerr magnetometry (P-MOKE) and magnetic force microscopy (MFM), respectively. Despite a lateral size distribution in the wide range between 100 nm and 1 µm and the various shapes, the perpendicularly magnetized dots adopt a monodomain state. A multidomain structure is observed very occasionally for the larger dots and for those with irregular shapes. Obtained results lead to the conclusion that in the studied epitaxial dots magnetization reversal takes place by nucleation of a reversed domain followed by the smooth domain wall propagation.

The magnetization reversal mechanism deduced from the experimental results has been successfully reproduced by micromagnetic simulations with the help of an object oriented micromagnetic framework (OOMMF) [2]. In the performed simulations we consider also a role of defects usually occurring in abundance in post-growth patterned structures. The influence of defects on the magnetization reversal mechanisms is discussed. Magnetization reversal of the dots is simulated as a function of magnetic anisotropy of the dots and defects as well as their size and the surface density.

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References

[1] A. Wawro, E. Sieczkowska, A. Petroutchik, L.T. Baczewski, Z. Kurant, A. Maziewski, *Phys. Rev. B* **83** (2011) 092405.
[2] J. Donahue and D.G. Porter, *National Institute of Standards and Technology Interagency Report No.6376*, NIST, Gaithersburg, 1999, http://math.nist.gov/oommf.