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Asymmetrical magnetic dots: A way to control chirality and coercivity

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Abstract – By means numerical simulations we have studied asymmetrical dots as a function of their geometry. We investigate how an instrinsic shape asymmetry affects vortex reversal. We find the vortices can be manipulated to annihilate at particular sites under different field orientations and cycling sequences.

In recent years, a great deal of attention has been focused on the study of regular arrays of magnetic particles produced by nanoimprint lithography. Besides the basis scientific interest in the magnetic properties of these systems, there is evidence that they might be used in the production of new magnetic devices, or as media for high density magnetic recording. [1] Control over domain structures in magnetic nanostructures is critical to the understanding and applications of such materials. [2]

Vortices are characterized by an in-plane magnetization with clockwise or counter-clockwise chirality and a central core with out-of-plane magnetization (up or down polarity). In realistic assemblies of dots, variations in dot shape, size, and intrinsic anisotropy inevitably exist and affect the reversal processes. In particular, dot asymmetry has been shown to lift the degeneracy in vortex chirality, therefore providing a means for chirality control. [3-5]

Dumas *et al.* [6] recently reported the synthesis and magnetic characterization of arrays of asymmetric Co dots where the circular shape in all the dots has been broken in the same fashion. In these arrays they demonstrated how the vortices can be manipulated to annihilate at particular sites under certain fields orientations and cycling sequences. Thus, this presentation focuses on the investigation of the magnetic properties of asymmetrical dots as a function of their geometry. By means numerical simulations of the hysteresis curves, we will study the different reversal modes present in these arrays. Besides, we will obtain magnetic phase diagrams giving the relative stability of characteristic internal magnetic configurations of the asymmetrical dots.

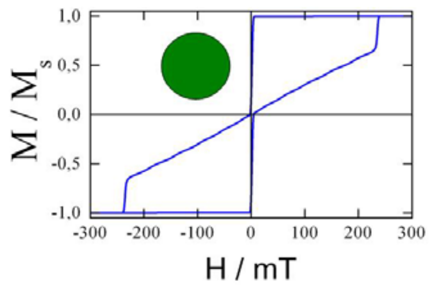

Figure 1: Hysteresis loop for a symmetric dot. We have simulated a dot with diameter of 80 nm and a height of 20 nm.

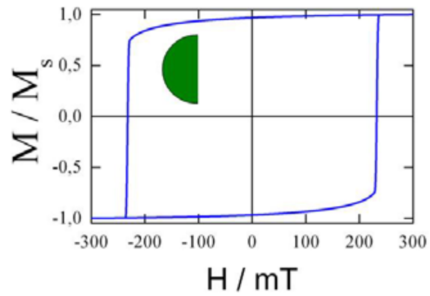

Figure 2: Hysteresis loop for an asymmetric dot. We have simulated an asymmetric dot with diameter of 80 nm and a height of 20 nm.

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