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Constriction effect on skyrmions properties

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Abstract

For the last years, magnetic skyrmions has been the focus of several studies on the research area of magnetism in condensed mater. This mainly drive by their potential application in new storage devices [1]. Skyrmions are magnetic textures topologically protected, and this topological structure has been found on several systems, such as chiral magnets, bulk crystals, and multilayered materials [2,3]. Multilayered materials, offer the possibility to nucleate skyrmions due to the Dzyaloshinskii-Moriya interaction (DMI) which generates an inversion symmetry breaking, originated from the interfaces between a heavy metal layer and the skyrmion-hosting magnetic layer [4]. In nanostructures (such as dots, squares, or triangles), DMI leads to a specific way of micromagnetic boundary conditions [5], due to the constrain state of domains in these structures in some cases the skyrmion state is more stable than labyrinth stripes and uniform magnetization. This work focusses on the effect of constriction on the nucleation behavior of skyrmions in dots with different diameters, made of Pt/Co/Ta multilayers, fabricated by magnetron sputtering deposition and electron beam lithography. These systems have been characterized by Scanning Electron Microscopy, Magnetic Force Microscopy and Magneto Optical Kerr Effect. Micromagnetic simulations, carried on Mumax3, are used to clarify the observed properties–as the breathing and movement process of skyrmions after the nucleation.

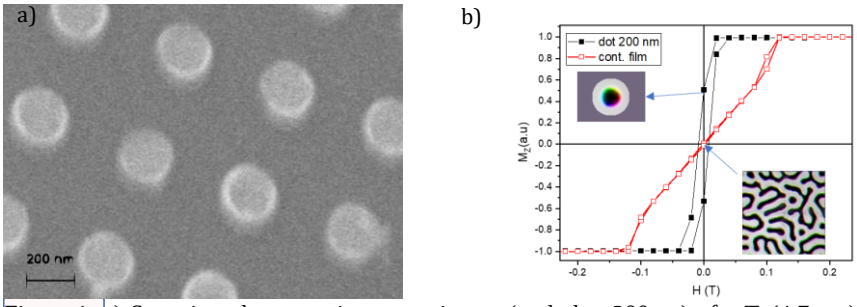

Figure 1: a) Scanning-electron-microscope image (scale bar 200nm) of a Ta(4.7 nm)/[Pt(4 nm)/Co (t)/Ta(1.9 nm)]15x dot array with 200nm diameter. b) Hysteresis curves obtained by micromagnetic simulation of a multilayer of Pt/Co/Ta, the red curve shows the continuous film, and the black curve is the case of a single nanodot of 200nm diameter. The remanent state corresponds to a skyrmion in the case of the nanodot and to labyrinth stripes in the case of the continuous film.

Comentado [JP1]: Si quieres, puedes poner la curva MOKE de la película continua.

Comentado [YUE2R1]: Eso pensaba pero no tiene mucha relación debido a que no es la simulación que tengo ahí

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References

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