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Anisotropy, Coercivity and Exchange Bias Fields in Core/Shell Ferrite Nanoparticles

J. Depeyrot[1], T. Q. Silva[1,2], G. Gomide[1], F. G. da Silva[1], R. Cabreira-Gomes[3], M. Gomes Viana[1], B. C. C. Pereira[1], P. Coppola[2], R. Perzynski[4], M. Vasilakaki[5], K. Trohidou[5],

[1]*Grupo de Fluidos Complexos, Instituto de Física - Universidade de Brasília, Brazil.*
[2]*Laboratório de Nanociência Ambiental e Aplicada, Faculdade UnB Planaltina - Universidade de Brasília, Brazil.*
[3]*Departamento de Física - Universidade Federal de Santa Catarina, Brazil*
[4]*Laboratoire PHENIX, Sorbonne Université, Paris, France*
[5]*Institute of Nanoscience and Nanotechnology, NCSR "Demokritos", Athens Greece*

Abstract: Symmetry breaking at the particle boundary of magnetic nanoparticles is a determining factor in their magnetic properties since it generally produces a structure with a magnetically ordered core and a shell with disordered spins. Ultrasmall particles are notorious for exhibiting a magnetization increase even at quite intense applied fields, behavior which can be interpreted as a non-saturation of the magnetic disordered shell even if the nanoparticle magnetization is reversible. This interface provides the appearance of unique interface effects such as the existence of an exchange coupling field, originating from magnetic interaction between core and shell spins lying at this interface [1, 2]. In this presentation, we will review the influence of the core/shell characteristics on the exchange coupling properties in hard/soft and soft/soft core/shell nanoparticles. In particular we will show how the contrast of magnetic anisotropy between core and shell, the nanoparticle size and the shell fraction tune the exchange bias field. For all investigated samples, we perform an extensive and systematic magnetic characterization in order to test the saturation criteria, then values of the exchange coupling field and coercivity are extracted from FC hysteresis loops as a function of the cooling field. To better understand the key mechanisms involved in the observed magnetic behavior, a mesoscopic scale approach and the Monte Carlo method has been employed and well reproduced the observed features [3]. Our results demonstrate the possibility to control the magnetic behaviour of nanostructures by using properly chosen core/shell bimagnetic nanoparticles

Key-words: nanoparticles, magnetic anisotropy, core-shell, exchange bias.
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