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Origin of Vertical and Horizontal Shifts in Nanoferrites

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Abstract – One of the most interesting system that may present unusual magnetic properties in nanoscale is the AFe_2O_4 (A is a transition metals), commonly known as ferrite. In this work, AFe_2O_4 (A = Ni or Zn) nanoparticles have been prepared by mechanosynthesis method and they have been characterized using Mössbauer spectroscopy and magnetization measurement. Previous results show us both vertical and horizontal shifts in the Ni nanoferrites. The shifts in the M(H) curves are based on the interfacial interaction between the surface spins, which is assumed to have structural spin disorder, and the FI core regions[1].

The nanostructured powders of ferrite AFe_2O_4 (A = Ni, Co and Zn) were prepared by mechanosynthesis using a SPEX8000 Ball Mill under well defined instrumental conditions at Espírito Santo Federal University (UFES).The magnetic properties of materials composed of magnetic nanoparticles are related to the intrinsic properties of the particles and their interactions[2]. In this work Mössbauer results indicate that after 100 hours of milling, the nanoferrite phases are formed with the Ni and Zn and the spectra are mainly composed of two paramagnetic doublets, at RT (Fig.1). These results are analyzed based on the core–shell model of the nanoparticles. While the Ni-ferrite nanoparticles have shown shifts of the M(H) hysteresis loops when cooling the sample in magnetic field from 320 K (horizontal = exchange bias and vertical loop shifts) (Fig. 2), the Zn-ferrite nanoparticles[3] only show the presence of conventional hysteresis loops. The explanation for the shifts of the M(H) curves are based on the interfacial interaction between the surface spins, which is assumed to have structural spin disorder, and the FI core regions.

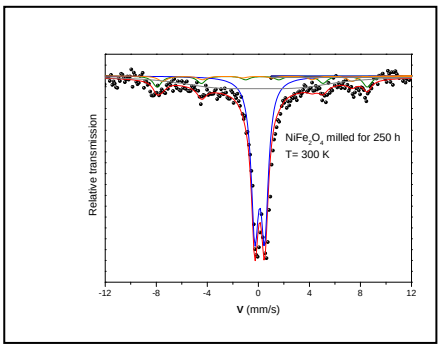

Figure 1: Mössbauer spectra of the Ni Ferrite milled for 250h recorded at RT.

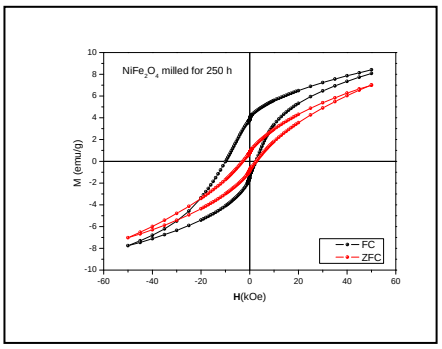

Figure 2: The ZFC and 50 kOe FC magnetic hysteresis loops at 5K. Both the horizontal and vertical shifts in the FC loop are apparent.

References

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