Characterization of the magnetocrystalline anisotropy field of magnesioferrite nanoparticles via magnetic resonance measurements

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In this work is described a study of the magnetic anisotropy of magnesioferrite nanoparticles (MgFe₂O₄) obtained by precipitation in magnesiowüstite [Mg, Fe]O single crystals. The X-band magnetic resonance spectra of this nanoparticles system can be considered as composed by two spectral lines: A broad line assigned to blocked particles at the measuring temperature and a thin line, which can be attributed to unlocked (superparamagnetic) particles. The anisotropy field of four samples treated at 700 °C during different annealing times were obtained from the angular variation of their broad spectral lines recorded with the samples easy magnetization axes oriented at 0° and 45° within the applied magnetic field. The use of a theoretical model to adjust the obtained anisotropy field data enabled the comparison of the obtained parameter values with those reported by other authors. Beyond the dependence of the anisotropy field with the measurement temperature and the samples treatment time, it was observed the presence of low field resonance lines that may be related to transitions usually considered as forbidden, which can be enabled by the degenerescence breaking caused by dipolar magnetic interactions between particles. Such considerably rare phenomenon in magnetic nanoparticles systems, was clearly observed in the present study not only for the half-field resonance line (2Q), but also for lines appearing at one third of field (3Q) and at one quarter of field (4Q). This feature shows that, at least in the investigated experimental system, the dipolar interactions between nearby particles cannot be always neglected as has been proposed by several other authors. The authors would like to thank the Brazilian agencies CAPES, CNPq and FAPEMIG for their financial support.

Keywords: magnetic resonance, size distribution, superparamagnetic, magnesioferrite, magnesiowüstite.