Sol-gel synthesis, micro-Raman studies and magnetic characterization of ε-Fe_2O_3 micro- and nanoparticles embedded in a SiO_2 matrix

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ABSTRACT

The ε-polymorph of iron (III) oxide shows very attractive properties, among them, its giant coercive field (around 2 T at room temperature, RT), its magnetoresistance or its millimeter wave ferromagnetic resonance (FMR) [1]. For these outstanding properties, ε-Fe_2O_3 nanoparticles are good candidates for the development of applications in fields such as electronics, as well as in a new generation of hard-magnets without rare-earth compounds. In the present work, we describe different synthesis routes in order to obtain ε-nanoparticles embedded in a SiO_2 matrix in powder form and as films deposited on Si(100) [2]. We have been able to fabricate ε-Fe_2O_3 nano- and microparticles, depending on the sol-gel path followed and the subsequent final thermal treatment chosen. We have investigated the magnetic properties spanning a wide range of temperatures and an extensive structural and morphological characterization of the samples is also carried out by Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), X-ray Diffraction (XRD) and Confocal Raman Microscopy (CRM) [2,3]. Specially, CRM is employed in order to identify the ε-phase from other iron oxides. In this sense, the evolution of the Raman spectra as a function of the temperature is analysed and compared in each case. Nevertheless, other phenomena are also studied, such as the structural transition from ε-phase to α-phase varying the output laser power, or the behavior when the material undergoes a Néel transition at 500 K [2].

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