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Characterization of $NiFe_2O_4/SiO_2$ xerogel and aerogel nanocomposites obtained by sol-gel process

N. D. S. Mohallem[1*] and J. B. da Silva[1,2]

1 Laboratório de Materiais Nanoestruturados, DQ/ICEx – UFMG, 31270-450, Belo Horizonte, MG, Brazil.

2 CDTN/CNEN –30123-970, Belo Horizonte, MG, Brazil.

Abstract

The changes on the properties of nano-composites formed by nickel ferrite nano-particles dispersed in xerogel and aerogel silica matrices were studied by increasing the temperature of preparation and the amount of ferrite dispersed in the silica matrix. Superparamagnetic behavior was observed for xerogels prepared at low temperature and for aerogels prepared at all heating temperatures. Magnetization of the nanocomposites varied from 9 to 43 emu.g^{-1} and the coercivity from 33 to 186 Oe, respectively, for the different morphologies and textures of the analyzed materials. The results showed that the porosity and drying conditions influence greatly the nano-composite magnetic behavior.

Key words: *Nickel ferrite nanocomposite, Magnetic nanocomposite, Ferrite/silica nanomagnetic system*

1. Introduction

Magnetic materials as nickel ferrites have been studied in the last years due to their applications in electronic devices, microwave adsorbents, corrosion protectors, magnetic fluids and catalysts (Rana, 2007; Lavela, 2007; Manova, 2007; Sousa, 2002; Maaz, 2009), among others. Haneda (1981) showed that nickel ferrite nanoparticles are applied to devices that require easy magnetization and demagnetization to produce high magnetic flux and magnetic induction by an external field. Nanoparticles with superparamagnetism behavior are the more adequate materials for this application due to their high magnetic mobility. Usually, nickel ferrites are synthesized as particulate materials, but these kind of materials have a strong tendency to aggregate, mainly when the particles have nanometric dimension. The dispersion of ferrites in an inert matrix reduces particle agglomeration and controls the particle distribution. This procedure reduces energy loss of the material and provokes coupling effects, improving their magnetic and mechanical properties. Silica xerogels and aerogels obtained by sol-gel process have adequate properties to be used as inert matrices, shown in later studies by da Silva (2001; 2005). These pazpers also showed that there is no direct interaction between the silica and the ferrites in the studied nanocomposites. Therefore, the distribution of the nanoparticles depends on the pore structure of the matrix network, which also affects the particle size. The drying step also plays an important role in determining the final pore structure of the materials obtained by sol-gel. When

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