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Synthesis and characterization of nanoparticles of cobalt and nickel ferrites dispersed in mesoporous silicon oxide

abstract

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Summary

Cobalt and nickel ferrites containing nanoparticles dispersed in silicon (Si) oxides were prepared via a polymeric precursor derived from the Pechini method [1]. The samples were characterized by X-ray diffraction (XDR), Mössbauer spectroscopy (MS), vibrating sample magnetometry (VSM) and N2 adsorption/desorption isotherms (BET). Therefore, investigations using XRD revealed that the spinel structure of CoFe2O4 (JCPDS 02-1045) and NiFe2O4 (JCPDS 44-1485) phases were formed and the crystallite sizes of the samples were calculated from the XRD patterns using the Debye–Scherrer formula and the calculated results indicate that the resultants are the nanometer-sized crystalline powders. Nevertheless, Mössbauer spectra revealed that the spinel structure of nickel and cobalt ferrite besides the presence of γ-Fe2O3. On other hand, Mossbauer spectroscopy measurements at 300K show that nanoparticles are in the superparamagnetic regime being completely blocked at 4.2K. The superparamagnetic relaxation due to maghemite and ferrites particles was also observed from magnetization measurement at 300 and 50K.
Furthermore, Brunauer–Emmett–Teller analysis shows that the ferrites has a high surface area between 439 and 346 m2.g–1 and Barrett–Joyner–Halenda method exhibit a narrow pore size distribution, with the majority of the porous diameter located in the range of 16 to 238 Å characteristic of mesoporous materials.
[1] A. Valentini et al. Micropo. Mesopor. Mater. 68 (2004) 151.

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