

Synthesis and Structure of Nanosize $\text{Ni}_x\text{Co}_{1-x}\text{Fe}_2\text{O}_4$ Particles

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Spinel ferrites are technologically important ceramic materials because of their excellent electrical and magnetic properties. These classes of materials have been widely used for three decades. Recently, progress in synthesis techniques has initiated a new surge of interest in ferrites in order to improve their physical properties and expand their applications. Ferros spinels, AFe_2O_4 , where A is Co, Ni, are a very important group of magnetic materials. They cover a wide range of applications from low wave-number to microwave and from low to high permeability including electronic devices, ferrofluids, magnetic drug delivery microwave devices and high density information storage [1]. Among the ferros spinels, the inverse type is particularly interesting due to its high magnetocrystalline anisotropy, high saturation magnetization, and unique magnetic structure.

Nanosize ferrites have been prepared by means sol-gel method with participation of auto-combustion. The chemical reagents used in the preparation were $\text{Ni}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, $\text{Co}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, $\text{Fe}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$, citric acid and distilled water. With constant stirring, the pH of the solution was adjusted to about 7 with ammonia solution. The present work deals with the synthesis and structure of nanoparticles of cobalt-doped nickel ferrite ($\text{Ni}_x\text{Co}_{1-x}\text{Fe}_2\text{O}_4$ where $x = 0.0, 0.1, 0.2, 0.3, 0.4$ and 0.5).

The phase identification of powders was performed by X-ray diffraction using DRON-3 diffractometer with Cu $K\alpha$ radiation. Surface morphology of the samples was investigated by a JEOL NeoScope JSM-5000 scanning electron microscope. Determination of structural and adsorption characteristics of synthesized samples was conducted by means of nitrogen adsorption/desorption isotherms with the automated sorptometer Quantachrome Autosorb (Nova 2200e).

Studies showed that all the synthesized powders possess single phase of ferrite with spinel structure. According to the obtained results of X-ray analysis and scanning electron microscopy it was determined that the synthesized powder was agglomerated, that was composed of several nanoparticles. It was observed that the lattice parameter decreases with increasing Ni^{2+} content x . This behavior of lattice parameter is explained on the basis of difference in ionic radii of Co^{2+} (0.72 Å) and Ni^{2+} (0.69 Å). The experimental result showed that pore size is in the mesoporous range according to IUPAC classification for all samples.

1. M.H. Sousa, F.A. Tourinho. New Electric Double-Layered Magnetic Fluids Based on Copper, Nickel, and Zinc Ferrite Nanostructures // *J. Phys. Chem. B.* – 2001. – V. **105**, №6. – P. 1168-1175.