Zn CONCENTRATION INFLUENCE OVER STRUCTURE, MORPHOLOGY AND MAGNETIC PROPERTIES OF Co_{(1-x)}Zn_{x}Fe_{2}O_{4} NANOPARTICLES IN FERROFLUIDS

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Ferrofluids based on single domain of Co_{(1-x)}Zn_{x}Fe_{2}O_{4} magnetic nanoparticles with a mean diameter of around 15 nm and dispersed in toluene as a liquid carrier, were prepared by co-precipitation method from aqueous salt solutions in an alkaline medium. The samples were characterized by Scanning Electron Microscopy (SEM), X-ray diffraction (XRD) and Vibrating Sample Magnetometer (VSM). Co_{(1-x)}Zn_{x}Fe_{2}O_{4} XRD patterns show the formation of spinel structure determined from the most intense peak that corresponds to the (311) crystallographic orientation. The mean size of the crystallite of nanoparticles, determined from Rietveld refinement, shows that it is diminished from 33 to 20 nm when the Zn concentration increases from 0.25 to 0.75. The magnetic hysteresis loops measured at room temperature for the Co_{1-x}Zn_{x}Fe_{2}O_{4} magnetic samples exhibit superparamagnetic behavior, from where was established that the coercive field decreases while the saturation magnetization M_s increases with the increasing of Zn at%. This magnetic behavior may be due to the partial substitution of non-magnetic Zn^{2+} ions that occupy tetrahedral interstitial sites and thereby changing the cation distribution in the spinel structure that can affect the magnetic moments alignment in the samples. Also from the Thamm – Hesse analysis we could establish that for highest magnetic field the magnetization change ?M (B) values are close to zero indicating that the existing interaction favors the superparamagnetic behavior of magnetic nanoparticles in the ferrofluid. This result has been predicted by the Stoner–Wohlfarth model for a system with a set of single domain-uniaxial anisotropy and non-interacting small magnetic particles. It showed that our magnetic nanoparticles can be considered as a soft magnetic material with interesting technological applications in nanotechnology, i.e., ferrofluids based on magnetic nanoparticles that under the action of an external magnetic field show optical properties that make them interesting as a magnetically tunable device.

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