International Journal of Applied and Natural Sciences (IJANS)
ISSN(P): 2319-4014; ISSN(E): 2319-4022
Vol. 6, Issue 2, Feb – Mar 2017; 47-60

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

ZN CONCENTRATION INFLUENCE ON THE STRUCTURE, MORPHOLOGY AND MAGNETIC PROPERTIES OF $Co_{(1-X)}Zn_XFe_2O_4$ NANOPARTICLES IN FERROFLUIDS

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ABSTRACT

Ferro fluids based on a single domain of $Co_{(1-x)}Zn_xFe_2O_4$ magnetic nanoparticles with a mean diameter of approximately 15 nm dispersed in toluene as a liquid carrier were prepared. The samples were characterized using scanning electron microscopy (SEM), X-ray diffraction (XRD) and vibrating sample magnetometer (VSM). XRD patterns show the formation of a spinel structure and allowed to determine the mean size of the crystallite of nanoparticles from the Rietveld refinement results, 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 for the magnetic samples exhibit superparamagnetic behavior, from which it was established that the coercive field decreases while the saturation magnetization M_s increases with the increase 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 change the cation distribution in the spinel structure and can affect the magnetic moment alignment in the samples. Additionally, using the Thamm–Hesse analysis, we could establish that the magnetization change values, ΔM (B), are close to zero for the highest magnetic field, indicating that the existing interaction favors the super paramagnetic behavior of the magnetic nanoparticles in the ferrofluid. This result has been predicted by the Stoner–Wolfforth model for a system with a set of single domain-uniaxial anisotropy and non-interacting small magnetic particles. The above result shows that our magnetic nanoparticles are materials with potential applications in nanotechnology for developing magnetically tunable devices.

KEYWORDS: Magnetic nanoparticles, Ferro fluids, Thamm–Hesse Analysis, Superparamagnetism