Structural and magnetic properties of mixed ferrite nanoparticles based on zinc copper and cobalt

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Ferrofluids rely on the union of magnetic properties of nanoparticles based on metal oxides with the fluidity of a carrier liquid, which provides great versatility in a wide range of applications[1]. We present here the study of ferrofluids based on nanoparticles of mixed ferrite of cobalt, zinc, and copper, elaborated in order to tune magnetization and magnetic anisotropy of ferrite magnetic nanoparticles by using the chemical composition. The investigation of such mixed ferrite nanoparticles is interesting to better understand the relationship between cationic distribution within the structure and to enhance the magnetic properties that are important for possible technological applications [1] . These NPs are obtained by hydrothermal coprecipitation in alkaline medium followed by a surface treatment that creates an iron-rich surface layer allowing their dispersions in acid medium [2]. NPs chemical composition is checked at each step of the synthesis by using atomic absorption spectroscopy and their structure investigated by X-Ray Diffraction (XRD) experiments realized on powder samples. Transmission Electron Microscopy (TEM) pictures show their morphology and allow a mean size determination, which well matches the one deduced from XRD analysis. Low field and high field DC magnetization experiments are combined with hysteresis loops measurements to characterize powders and liquid samples. Then, we extract the thermal dependence of both saturation magnetization and coercivity of nanoparticles. The temperature dependence of magnetization is explained in the framework of Bloch's law and the coercivity is compared to Kneller's law. The produced nanoparticles present very high saturation magnetization values, as well as coercivity, making them promising candidates for several applications. The results obtained by applying the Rietveld refinement method to the X-ray diffractograms allowed us to correlate the structural properties such as cation distribution to the magnetic properties. Moreover To validate the applicability of the synthesized NPs in biomedical scenarios, we have carried out magnetohyperthermia essays, which indicate a very good potential of these NPs in such applications.

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