Synthesis of Fe₃O₄ Nanoparticles from Iron Sands and Effects of Ni and Zn Substitution on Structures and Magnetic Properties

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Abstract: The Fe₃O₄ and NiₓZn₁₋ₓFe₂O₄ nanoparticles have successfully been synthesized from iron sands by co-precipitation method. The XRD spectra have confirm the samples to be single crystalline phase of magnetite Fe₃O₄ and NiₓZn₁₋ₓFe₂O₄ phases. The samples prepared from iron sands contains several elemental impurities, which act as dopants substituting some part of Fe in the spinel structure, without forming any other individual phase. The lattice parameter and crystal size were found within the range of 8.376 ± 0.006 – 8.410 ± 0.004 nm and 19.86 ± 0.95 – 38.10 ± 4.08 nm, respectively, depending on Ni and Zn (x) content. The particles dominated by primary particles with spherical shape were confirmed by TEM. The magnetic measurements showed superparamagnetic nature of all various samples with improvement in remanence and coercivity with various x. The saturation magnetization samples is low and increases with increasing Ni content with exception for x = 0.5 which is the highest value (Ms = 66.88 emu/gr). The varying properties of the Fe₃O₄ and NiₓZn₁₋ₓFe₂O₄ nanoparticles using iron sands as a source of Fe²⁺/Fe³⁺ ions offers an alternative to synthesize nanoferrites in large scale applications.

Key words: Iron sands, nanoparticles, magnetic properties, co-precipitation.