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Magnetic properties for $Zn_{0.05}Fe_{2.95}O_4$ microparticles

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The Zn doped Fe_3O_4 have been suitable material for biological applications [1]. $Zn_{0.05}Fe_{2.95}O_4$ have highest saturation magnetization (M_S) value at room temperature among the Zn doped iron oxides. The $Zn_{0.05}Fe_{2.95}O_4$ microparticles were prepared by a solvothermal reaction method. The magnetic and crystallographic properties of sample were investigated using x-ray diffraction (XRD), field emission scanning electron microscope (FESEM), vibrating sample magnetometer (VSM), and Mössbauer spectroscopy. From the XRD results, crystal structure of $Zn_{0.05}Fe_{2.95}O_4$ sample was found to be cubic spinel (*Fd-3m*) with lattice constant a_0 = 8.415 Å. The particle size of the sample was determined to be 574 nm with spherical shape by FESEM measurements. From measured the M-H curve, the M_S and coercivity (H_C) value at room temperature of $Zn_{0.05}Fe_{2.95}O_4$ microparticles were 97.0 emu/g and 83 Oe, respectively. The Mössbauer spectra of $Zn_{0.05}Fe_{2.95}O_4$ sample at various temperatures were composed of four six-line (trivalent valence state one A site and mixed valence state three B site). From the Mössbauer analysis, the isomer shift value (δ) of A and B_1, B_2, B_3 sites at 4.2 K are 0.42 (Fe^{3+}) and 0.33 (Fe^{3+}), 0.35 (Fe^{3+}), 0.90 (Fe^{2+}) mm/s. The magnetic hyperfine field (H_{hf}) of A and B_1, B_2, B_3 sites at 4.2 K are 527 and 510, 501, 487 kOe, respectively.

[1] M. Cho et al, Nature Mater. 11, 1038 (2012).