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Studies on structural, optical and magnetic properties of Cobalt Substituted Magnetite Fluids ($Co_xFe_{1-x}Fe_2O_4$)

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Abstract: In the current work, ferrofluids belonging to the series $Co_xFe_{1-x}Fe_2O_4$ with Co concentration (x =0 to 0.8) are synthesized by chemical co-precipitation technique. Structural, magnetic and optical properties of these ferrofluids have been investigated. The XRD results confirm the single phase cubic spinal structure belonging to the space group (Fd3m). The samples exhibit polycrystallinity with almost negligible impurities. Analyses of TEM demonstrate size distribution of the prepared nanoparticles in the range of 6-11nm that are almost spherical in shape. Optical absorption spectra depict band edges of the samples ranging from 3 to 3.7eV which is attributed by finite quantum confinement effect. Magnetic response of the ferrofluids at room temperature probed through VSM studies reveals that substituting cobalt for iron in magnetite change coercivity from 123 Oe (ferromagnetic) to 0 (superparamagnetic) states. The saturation magnetization and remanence are found to increase upto x=0.4 and then significantly decreases for x=0.6-0.8 arising due to effects of exchange interaction between the tetrahedral and octahedral sub lattices. Magnetic control of the optical properties for different concentrations is achieved in these fluids.