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Monodisperse Quaternary Cobalt Chromium Ferrite Nanoparticles Synthesised from a Single Source Precursor

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Abstract : The synthesis of spinel ferrite nanoparticles with a narrow size distribution is very crucial in their numerous applications including information storage, hyperthermia treatment, drug delivery, contrast agent in magnetic resonance imaging, catalysis, sensors, and environmental remediation. Ferrites have the general formula MFe2O4 (M = Fe, Co, Mn, Ni, Zn etc.) and possess remarkable electrical and magnetic properties which depend on the cations, method of preparation, size and their site occupancies. To the best of our knowledge, there are no reports on the use of a single source precursor to synthesise quaternary ferrite nanoparticles. Herein, we demonstrated the use of trimetallic iron pivalate cluster [CrCoFeO(O2CtBu)6(HO2CtBu)3] as a single source precursor to synthesise monodisperse cobalt chromium ferrite (FeCoCrO4) nanoparticles by the hot injection thermolysis method. The precursor was thermolysed in oleylamine, oleic acid, with diphenyl ether as solvent at its boiling point (260°C). The effect of concentration on the stoichiometry, phases or morphology of the nanoparticles was studied. The p-XRD patterns of the nanoparticles obtained at both concentrations were matched with cubic iron cobalt chromium ferrite (FeCoCrO4). TEM showed that a more monodispersed spherical ferrite nanoparticles of average diameter 4.0 ± 0.4 nm were obtained at higher precursor concentration. Magnetic measurements revealed that all the ferrite particles are superparamagnetic at room temperature. The nanoparticles were characterised by Powder X-ray Diffraction (p-XRD), Transmission Electron Microscopy (TEM), Inductively Coupled Plasma (ICP), Electron Probe Microanalysis (EPMA), Energy Dispersive Spectroscopy (EDS) and Super Conducting Quantum Interference Device (SQUID).

Keywords : quaternary ferrite nanoparticles, single source precursor, monodisperse, cobalt chromium ferrite, colloidal, hot injection thermolysis
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