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The Effect of Reaction Time on the Morphology and Phase of Quaternary Ferrite Nanoparticles ($FeCoCrO_4$) Synthesised from a Single Source Precursor

Authors : Khadijat Olabisi Abdulwahab, Mohammad Azad Malik, Paul O'Brien, Grigore Timco, Floriana Tuna

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 MFe_2O_4 (M = Fe, Co, Mn, Ni, Zn e.t.c) 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. Here in, we demonstrated the use of trimetallic iron pivalate cluster $[CrCoFeO(O_2C^tBu)_6(HO_2C^tBu)_3]$ as a single source precursor to synthesise monodisperse cobalt chromium ferrite ($FeCoCrO_4$) nanoparticles by the hot injection thermolysis method. The precursor was thermolysed in oleylamine, oleic acid, with diphenyl ether as solvent at 260 °C. The effect of reaction time on the stoichiometry, phases or morphology of the nanoparticles was studied. The p-XRD patterns of the nanoparticles obtained after one hour was pure phase of cubic iron cobalt chromium ferrite ($FeCoCrO_4$). TEM showed that a more monodispersed spherical ferrite nanoparticles were obtained after one hour. Magnetic measurements revealed that the ferrite particles are superparamagnetic at room temperature. The nanoparticles were characterised by Powder X-ray Diffraction (p-XRD), Transmission Electron Microscopy (TEM), Energy Dispersive Spectroscopy (EDS) and Super Conducting Quantum Interference Device (SQUID).

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