SYNTHESIS, SPECTROSCOPIC, AND MAGNETIC CHARACTERIZATION OF CoFe$_2$O$_4$, NiFe$_2$O$_4$, AND Co$_{0.5}$Ni$_{0.5}$Fe$_2$O$_4$ NANOPARTICLES OBTAINED BY A SOLUTION COMBUSTION METHOD

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CoFe$_2$O$_4$ and NiFe$_2$O$_4$ are interesting ferrimagnetic materials of spinel-structure.$^{[1]}$ The reported magnetization at 5.0 T of them vary in between 50 and 61.8 emu/g.$^{[1]}$ The coercivity (Hc) is in the order of 136 Oe.$^{[1]}$ Ferrites with spinel-structure have applications in information storage systems, magnetic bulk cores, magnetic fluids, microwave absorbers and medical diagnostics.$^{[2]}$ This work deals with the synthesis and characterization of CoFe$_2$O$_4$, NiFe$_2$O$_4$, and Co$_{0.5}$Ni$_{0.5}$Fe$_2$O$_4$ nanoparticles. The synthesis method used was solution combustion, assisted by glycine as a fuel. The nanoparticles of cobalt and nickel ferrites were synthesized using nitrate ions/glycine ratios of 3 and 6. When the ratio of 3 was used, a flame evolved when the water was evaporated. On the other hand, when a ratio of 6 was used, brown gases of NO$_2$ were evolved owing to incomplete reduction of the nitrate ions. To improve the crystallinity of the ferrites, the samples were annealed at 600 °C for 2 h. X-rays diffraction (XRD) and Raman spectroscopy were used to confirm the formation of the ferrites. Crystallite sizes of the three kinds of nanoparticles, determined using the Scherrer equation, were ~ 72 nm. The diffraction peaks of the synthesized Co$_{0.5}$Ni$_{0.5}$Fe$_2$O$_4$ phase coincided in intensity and position with the PDF 0—083-6066. Therefore, the used synthesis method is suitable for obtaining this ferrite. When a ratio of 3 was used, the Ni(II) cations were reduced to nickel by the glycine. However, the Co(II) cations were not reduced to metallic cobalt. The magnetic behavior of all three nanostructures have been studied and discussed.

References


Keywords: solution combustion, cobalt and nickel ferrites, magnetic properties

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