Investigations on the Structural, Morphological, Electrical, and Magnetic Properties of $CuFe_2O_4$−NiO Nanocomposites

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$CuFe_2O_4$−xNiO (x = 1, 5, 10, and 20 wt %) nanocomposites have been successfully prepared by a simple combustion method using urea−nitrate precursors. The samples were sintered at different temperatures, namely 600, 800, 1000, and 1100 °C, for 5 h to enhance the compound formation and phase purity, studied by means of XRD patterns. Then the 1100 °C sintered sample was further characterized for its structural (EXAFS, XANES, FT-IR, UV–vis), morphological (SEM, TEM, HRTEM, SAED), electrical (ac conductivity, dielectric constant, dielectric loss tangent), and magnetic (Mössbauer) properties. The EXAFS and XANES studies reveal the formation of $NiFe_2O_4$ and CuO, in addition to the existence of $CuFe_2O_4$ and NiO phases. A partial substitution of metal cations by nickel ions could also be evidenced. The stretching and bending vibration of the tetrahedral and octahedral complexes have been established from FT-IR spectra. The UV–vis spectra elucidate that the prepared materials are semiconductors and also show the quantum size confinement effect. The well-defined grain and grain boundary structure was identified from the SEM studies. The nanosize of the synthesized materials has been identified by TEM investigations. The HRTEM and SAED images reveal the crystallinity and polycrystalline behavior of the as-synthesized materials. The electrical studies show the normal ferrimagnetic behavior of the materials. The inverse spinel nature of the materials has been enumerated from Mössbauer spectra, which also illustrates the phase transition behavior.