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Influence of rare-earth elements (RE = Ce, Nd, Gd) on Structural, ESR and Mössbauer spectroscopy studies of Ni0.5Co0.5RE0.03Fe0.197O4 synthesized by glycol-thermal method

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Nanocrystalline Ni0.5Co0.5RE0.03Fe0.197O4 (RE = Ce, Nd, Gd) were synthesized by glycol-thermal method. X-ray diffraction (XRD) results confirm the formation of single-phase spinel ferrite. The crystallite sizes ranged from 6.29 nm to 9.41 nm which was comparable to results obtained using Williamson-Hall (W-H) method. Lattice parameters were found to vary from 8.356 Å to 8.370 Å depending on an atomic radius of a substituted rare-earth element. Large specific surface areas ranging between 120 m2/g and 160 m2/g were associated with smaller crystallite sizes. Scanning electron microscope (SEM) revealed homogeneous and clustered nanoparticles. The energy dispersive X-ray (EDS) spectra revealed the existence of nickel (Ni), cobalt (Co), iron (Fe), and oxygen (O) in an undoped sample, as well as additional characteristic peaks of cerium (Ce), neodymium (Nd) and gadolinium (Gd) were observed for doped samples. Fourier transform infrared spectroscopy (FTIR) also confirmed the formation of spinel ferrites. The electron spin resonance (ESR) results demonstrated g-values ranging between 3.10 and 3.79 which indicated strong exchange interaction between nanoparticles, type of morphology, and crystalline nature of particles. These high values make Ni0.5Co0.5RE0.03Fe0.197O4 (RE = Ce, Nd, Gd) materials suitable for applications in high-frequency devices. The Mössbauer spectroscopy results revealed the formation of broadened Zeeman lines and quadrupole-split lines as well as the presence of the Fe3+ ions at B sites in the samples.

Apply to be considered for a student ; award (Yes / No)?

No

Level for award;(Hons, MSc, PhD, N/A)?

N/A

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