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Effect of rare-earth doping on structural and magnetic properties of Ni-Mg spinel ferrite

Nanocrystalline Ni0.5Mg0.5RE0.03Fe1.97O4 (RE =Dy3+, Pr3+, and Sm3+) nanoferrites were synthesized using the hydrothermal method. The X-ray diffraction (XRD) and The Fourier transform infrared spectroscopy (FTIR) confirmed the formation spinel structure. The obtained crystallite sizes ranged between 9.33 and 22.89 nm, while lattice parameters increased from 8.285 to 8.462 Å depending on the ionic radii of dopants. X-ray densities ranged between 4.761 and 5.021 g/cm^3. The specific surface area (SSA) ranged between 52.3 and 125.9 m^2/g. Hopping lengths on A- and B-sites ranged between 3.588 and 3.664 and 2.929 and 2.991 Å, respectively. The scanning electron microscopy (SEM) revealed physically shaped and agglomerated nanoparticles. The evolution of coercive fields upon reducing the measuring temperature from room temperature (300K) to 4K indicates the thermal instability of the blocked magnetic moments. Relatively high coercive fields make the materials suitable for application in transformers and high-frequency devices.

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