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Structural and magnetic properties of $\text{NiFe}_2\text{O}_4/\text{NiFe}$ bi-magnet and NiFe nano-alloy synthesized from thermal reduction of NiFe_2O_4

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Abstract content (Max 300 words) Formatting & Special chars

Bi-magnetic $\text{NiFe}_2\text{O}_4/\text{NiFe}$ nanocomposites and NiFe nano-alloy were synthesized by reduction of NiFe_2O_4 nano-ferrite with activated charcoal in flowing high purity Ar gas atmosphere at 900 °C for 3 hours. The parent NiFe_2O_4 nano-ferrite was synthesized by a glycol-thermal method at 200 °C. Partial and complete reduction yielded $\text{NiFe}_2\text{O}_4/\text{NiFe}$ nanocomposites and NiFe nano-alloy respectively. NiFe was formed at an optimum amount of $x = 5$. Phase identification, morphology and magnetic properties of the samples were performed by XRD, HRSEM, HRTEM, ^{57}Fe Mössbauer spectroscopy and a mini cryogenic-free system. The parent sample has an average crystallite size of about 10 nm, an XRD density of about 5.3 g/cm³ and an average lattice parameter of $a = 8.362 \pm 0.007 \text{ \AA}$. The NiFe nano-alloy exhibited the martensite bcc ($\alpha\text{-Fe}$) and austenite fcc ($\gamma\text{-Fe}$) phases in coexistence. Fitted Mössbauer analysis for $x = 5$ and 6 show high hyperfine magnetic fields associated with the bcc phase while the lower field component is associated with the fcc phase of NiFe nano-alloy. The saturation magnetization increased significantly from 57 emu/g to 141 emu/g at room temperature. The saturation magnetization is enhanced at low temperatures with a maximum of 161 emu/g at $\geq 30 \text{ K}$. However, the coercivity showed no significant increase at low temperatures.

Keywords: Nano-ferrite; Nano-alloy; Nanocomposites; Activated charcoal; martensite; austenite; Reduction reaction

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YES

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

PhD

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