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Synthesis, structural and magnetic properties of Ni0.5Ti0.5Fe2O4

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Nickel base ferrites of the spinel structure have been reported to have interesting properties such as low coercivity, high saturation magnetization, chemical and thermal stability. These qualities allow the materials to be used in applications such as gas sensors, magnetic fluids, magnetic storage systems. The properties of NiFe2O4 can be tuned by doping in the A or B sites of the spinel structure. Furthermore, the synthesis technique used has great influence on the resulting properties. Hence, we have successfully synthesized a polycrystalline Ni0.5Ti0.5Fe2O4 compound by high energy ball milling. To our surprise the phase quickly takes form as early as 0.25 hours. The sample was milled for 10 hours. Prolonged milling destroyed the phase. From the structural analysis it is evidence that starting precursors for a chemical reaction are of vital importance as they have great influence on the reaction product. The mean particle size was obtained to be 45.2±9.4 nm. Particle size reduces with milling time whilst the strain increases. The density is inversely proportional to the lattice parameters. Intriguingly, The coercivity and saturation magnetization followed Stoner Wohlfarth model with two distinct regions at high temperature (300-100) and low temperature (50 -10) with approximately equal anisotropy. Saturation magnetization was obtained to be between 38.73 to 38.84 ± 0.03 emu/g and the coercivity is between 820 to 407 ± 32 Oe. Room temperature Mossbauer revealed hyperfine fields of 446 ± 1 kOe and 480 ± 1 kOe for A and B sites respectively. Isomer shift values revealed co-existence of both F3+ and Fe2+. The interesting and intriguing properties displayed by the material serves as great potential and open room for further investigation.

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