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Magnetic Properties and Mössbauer Studies of Fe_3O_4 Substituted with Gd Ions

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The $Gd_{0.05}Fe_{2.95}O_4$ nanoparticles were synthesized by seed - mediated growth and were reacted for 30, 45, 60 and 75 min (Gd_{30}, Gd_{45}, Gd_{60} and Gd_{75}), respectively. The samples structural and magnetic properties were investigated by x-ray diffraction (XRD), vibrating sample magnetometry (VSM), and Mössbauer spectroscopy. The self-heating properties were investigated by using a MagneTherm device. According to XRD analysis, gadolinium (Gd) nanoparticles found to be a cubic spinel structure has a space group *Fd-3m*. The lattice constant (a_0) of Gd nanoparticles are 8.3633 Å and increases to 8.3721 Å as the high-temperature reaction time increases. The particle size was determined using Scherrer's equation and the maximum particle size was 10.84 nm. The maximum saturation magnetization (M_S) value of Gd_{60} at room temperature was 63.10 emu/g. The self - heating temperature of Gd_{60} at 112 kHz and 250 Oe was measured and 63.3 °C was the highest. Gd_{60} had the largest particle size and highest M_S and self-heating properties were measured. Mössbauer measurements were performed to investigate hyperfine interactions at from 4.2 to 290 K.

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