Exceptional magnetic properties of Fe substituted nickel chromite

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The $NiCr_{2-x}Fe_xO_4$, (x=0.1, 0.3, 0.5) samples have a cubic structure at room temperature. For the sample with x=0.1, the lattice constant is determined to be a_0=8.319 Å with a cubic spinel (Fd-3m) structure. The ferrimagnetic Néel temperature (T_N) of $NiCr_2O_4$ is determined to be 80 K by zero field cooled magnetization curves under the external field of 100 Oe. With increasing Fe substitution, T_N increases, and for x=0.1, T_N is determined to be 135 K. For the sample with x =0.1, the Mössbauer spectrum at 4.2 K was fitted to two magnetic components of the magnetic hyperfine fields H_{hf}=488 and 472 kOe and isomer shifts δ=0.29 and 0.28 mm/s. The electric quadrupole splittings (ΔE_Q) were found to be nearly zero below the T_N=135 K. For the spectrum at 295 K, the ΔE_Q are observed with large values of 0.54 and 0.37 mm/s, respectively. The values of the isomer shifts show that for all temperature ranges, the states are ferric (Fe^{3+}). The Mössbauer spectra below the T_N show the line broadening with the Jahn-Teller distortion and accompanying relaxation effects, respectively. © *2007 American Institute of Physics*. [DOI: 10.1063/1.2712325]