The Magnetic Behaviors of Spin-Glass $FeGa_2O_4$ System

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We present the investigation of magnetic properties of spin-glass $FeGa_2O_4$ system. From X-ray diffraction patterns of $FeGa_2O_4$, refined with Rietveld's refinement method, its structure is determined to be cubic spinel with space group $Fd-3m$ and the lattice parameter of $a_0 = 8.385$ Å. From temperature-dependent magnetization curves under 1000 Oe, the Néel temperature is found to be $T_N = 14$ K, which coincides with the value obtained from the Mössbauer spectrum. The freezing temperature T_f of the sample shifts to higher temperature with increasing frequency, as seen in conventional metallic spin glasses. Also, we have determined the small activation energy, E_a of 1.04266×10^{-4} meV from Arrhenius law $\nu = \nu_0 \exp(-E_a/k_B T_f)$, where k_B is Boltzmann constant, and E_a is activation energy. The Mössbauer spectrum at 4.2 K shows severely distorted 8-line shape coming from frozen spin-disorder state and an incommensurate spin structure, as in spin glasses. The change in the electric quadrupole shift above T_f is caused by the presence of the maximum electric dipole interaction among frozen disordered spins around T_f as in spin-glass material, and charge re-distribution from spin-relocation arising above T_N.

Index Terms—**Arrhenius law, freezing temperature, frozen disordered spin, spin-glass.**