Spin-Ordering Leading Magnetic Transition in Sulphur System ACr_2S_4 (A = Fe and Zn)

Bae Soon Son, Sung Hwan Bae, Sam Jin Kim, and Chul Sung Kim

Department of Physics, Kookmin University, Seoul 136-702, Korea

Magnetic structure of $Fe_{1-x}Zn_xCr_2S_4$ $(0.1 \leq x \leq 0.9)$ has been studied with magnetic susceptibility, x-ray diffraction and Mössbauer spectra. The crystal structures are found to have a cubic spinel with space group $Fd3m$. The lattice constants decrease with increasing Zn concentrations. According to magnetic susceptibility measurements, Néel temperature (T_N) decreases with increasing Zn concentrations from $x = 0.5$ to 0.7, especially T_N dramatically decreases from 105 K to 45 K. The magnetic ground state reveal transition from ferrimagnetic to anti-ferromagnetic behavior at $x = 0.7$. It is interpreted that the order of magnetic ions between tetrahedral (A) site ion and octahedral (B) site ion is antiparallel. The Mössbauer spectra show asymmetrical shapes due to large electric quadrupole interaction, magnetic hyperfine field of samples decrease in ferrimagnetic behavior ranges and increase in antiferromagnetic behavior ranges at 4.2 K. The magnetic hyperfine field of all samples for Zn concentration $x = 0.1$, 0.3, 0.5, 0.7 and 0.9 are 156, 128, 116, 131 and 138 kOe, respectively. It is described that the magnetic dipole interaction was weakened as substituting Zn ions in replacement of Fe on A site.

Index Terms—**Magnetic structure transition, Mössbauer Spectroscopy, sulphur spinel.**