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DP-16. Mössbauer study of magnetic structure of cation-deficient iron sulfide $Fe_{0.92}S$. *W. Kim*[1], I. Park[1] and C. Kim[1] *1. Department of Physics, Kookmin University, Seoul, South Korea*

The iron-sulfide, Fe-S system shows interesting crystallographic and magnetic properties [1]. Recently, cation-deficient iron sulfide $Fe_{0.92}S$ has received considerable interests because of their potential applications in phase-change magnetic memory [2]. We have investigated the magnetic hyperfine structure of iron sulfide $Fe_{0.92}S$ by Mössbauer spectroscopy, and studied its magnetic properties. From the x-ray diffraction pattern, $Fe_{0.92}S$ is found to be 3c-type hexagonal superstructure of the NiAs structure. The Mössbauer spectra were taken at various temperatures ranging from 4.2 to 615 K. The spectra consists of three-component sub-spectra arising from three magnetically non-equivalent sites in the 3c superstructure. The magnetic hyperfine fields of the three A, B, and C sites at 4.2 K are found to be 328, 276, and 247 kOe, respectively. These values are in the ratio of 18:15:14, which is close to the ratio of the magnitudes of magnetic hyperfine field in 18, 14, and 13 interplanar superexchange links (Fe-S-Fe) of A, B, and C three sites, respectively. Absorption intensity and quadrupole shifts for A and B sites change substantially over the temperature range from 550 K, suggesting that a vacancy rearrangement is taking place. Isomer shifts indicate Fe^{2+} states for all three sites. The Néel temperature (T_N) and the Debye temperature are found to be 615 ± 5 K and 238 ± 1 K, respectively. Magnetization curve for $Fe_{0.92}S$ at room temperature show ferromagnetic behavior unlike antiferromagnetic FeS. The coercivity values (H_C) and remanent magnetization (M_R) are 426 Oe and 5.7 emu/g, respectively. A cusp-like anomaly is observed in zero-field-cooled (ZFC) magnetization curve under the 100 Oe. ZFC magnetization curve shows an abrupt rise above 375 K, reaching equilibrium value. Near 550 K, it starts dropping rapidly, which can be associated with a mass transport (i.e., vacancy rearrangement).

[1] Y. Fei, C. T. Prewitt, H. K. Mao, and C. M. Berka, Science 268, 1892 (1995). [2] T. Takayama and H. Takagi, Appl. Phys. Lett. 88, 012512 (2006).