Magnetic Properties of Iron Sulfides Doped with 3d Transition-Metals

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It is found by Mössbauer measurements on Mn1-xFe2xS (M=Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu) that the 3d-transition metal impurities profoundly affect both the crystallographic and spin rotation transitions of iron sulfide. It is noteworthy that both V0.5Fe0.5S and Co1.2Mn0.8S have Morit transition temperatures Tm which are distinctly different from that of FeS; furthermore, the directions of changes of Tm are opposite for V0.5Fe0.5S and Co1.2Mn0.8S. A vanadium impurity of 2.5% of the metal atoms in the iron sulfide makes the crystallographic transition take place rapidly in a narrow temperature range of about 15 K, while the α transition in FeS takes place over a wide temperature range of about 200 K. It is also found that the transition for V0.5Fe0.5S has a hysteresis width of 5 K. It is very interesting that the crystallographic transition is independent of the lattice parameters while the spin rotation transition is dependent on them.

Index Terms – phase transition, 3d-transition metal, spin rotation

The Effect of Manganese Substituted M-type Hexagonal Ba-ferrite

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The effect of manganese substitution in ferrimagnetic Ba-ferrite (BaFe2+2MnxO6, 0 ≤ x ≤ 6) was investigated by crystallographic and magnetic characteristic measurements. Mn substituted Ba-ferrite polycrystalline powder samples were prepared by modified HTTD (High Temperature Thermal Decomposition) method. The crystal structure of x=0, 2, 4 and 6 samples revealed a $M$-type hexagonal structure with space group P6$_3$/mmc by Rietveld refinement. The lattice constant a$_0$ was increased and c$_0$ was decreased with increasing Mn substitution as if it was extended along the a$_0$ axis direction. Magnetic Curie temperature ($T_C$) was linearly decreased as shown in temperature dependence of zero field cooled (ZFC) magnetization curve data. Fig. 1 show the Mössbauer spectra of BaFe$_{2.2}$Mn$_{0.8}$O$_6$ (0 ≤ x ≤ 6) at 200 K. Mössbauer spectra of all samples were analyzed by five sublattice sites such as 4f$_2$, 2a, 4f$_1$, 12k, 2b in magnetoplumbite structure for the site occupancy and hyperfine interaction of Fe$^{3+}$ ions. The site occupancy of Fe$^{3+}$ in each sublattice was analyzed by relative area $S(4f)$. From these area ratio, the number of iron ions (NFe(4f)) occupied in each five site was calculated, simultaneously, how many Mn ions occupied in Ba-ferrite are obtained. The line-width broadening of Mössbauer spectra with increasing Mn concentration were originated from the effect of a cooperative Jahn–Teller octahedral distortion.

REFERENCES