

BD07

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

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It is found by Mössbauer measurements on  $M_{0.025}Fe_{0.975}S$  ( $M=Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Cu$ ) that the 3d-transition metal impurities profoundly affect both the crystallographic and spin rotation transitions of iron sulfide. It is noteworthy that both  $V_{0.025}Fe_{0.975}S$  and  $Co_{0.025}Fe_{0.975}S$  have Morin transition temperatures  $T_M$  which are distinctly different from that of FeS; furthermore, the directions of changes of  $T_M$  are opposite for  $V_{0.025}Fe_{0.975}S$  and  $Co_{0.025}Fe_{0.975}S$ . 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 region of about 15 K, while the  $\alpha$  transition in FeS takes place over a wide temperature range of about 200 K. It is also found that the transition for  $V_{0.025}Fe_{0.975}S$  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

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

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The effect of manganese substitution in ferrimagnetic Ba-ferrite ( $BaFe_{12-x}Mn_xO_{19}$ ,  $0 \leq x \leq 6$ ) 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.[1] 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  $a_c$  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  $BaFe_{12-x}Mn_xO_{19}$  ( $0 \leq x \leq 6$ ) 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  $Fe^{3+}$  ion in each sublattice was analyzed by relative area  $S(i)$ . [2] From these area ratio, the number of iron ions ( $N_{Fe(i)}$ ) 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.[3]

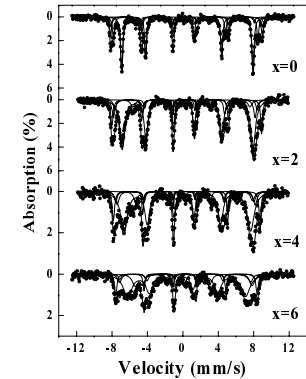


Fig. 1. Mössbauer spectra of  $BaFe_{12-x}Mn_xO_{19}$  ( $0 \leq x \leq 6$ ) at 200 K.

#### REFERENCES

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