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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 α 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

BD08

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_o was increased and c_o was decreased with increasing Mn substitution as if it was extended along the a_o 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 *4f₂, 2a, 4f₁, 12k, 2b* in magnetoplumbite structure for the site occupancy and hyperfine interaction of Fe^{3+} ions. The site occupancy of Fe^{3+} ion in each sublattice was analyzed by relative area *S(i)*.[2] From these area ratio, the number of iron ions (*NFe(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]

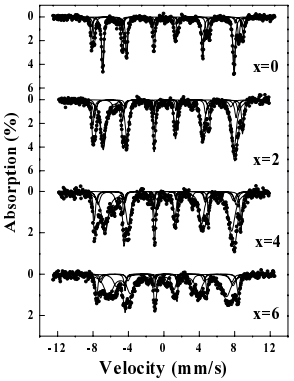

Fig. 1. Mössbauer spectra of $BaFe_{12-x}Mn_xO_{19}$ ($0 \leq x \leq 6$) at 200 K.

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