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structure was determined to be cubic spinel with its lattice constant $a_0 = 9.999 \text{ \AA}$. The Mössbauer spectra were recorded from 4.2 K to room temperature. The asymmetric line broadening is observed and considered to be dynamic Jahn-Teller distortion. The unusual reduction of magnetic hyperfine field below 100 K may be explained in terms of cancellation effect between the mutually opposite orbital current field (H_L) and Fermi contact field (H_C). Isomer shift value of the sample at room temperature was 0.58 mm/s, which means that charge state of Fe ions was ferrous in character. The Néel temperature (T_N) was 178 K. The MR peak was observed at 192 K about 10 % at an applied field 2 T. The activation energy above the Néel temperature was calculated to be 50 meV. The conduction mechanism of Mn perovskites is accompanied with electron hopping between heterogeneous Mn^{3+} and Mn^{4+} , but in this sample there is no heterovalance in iron ions [1]. The conduction mechanism in this sample was completely different from double exchange interaction.

- [1] A. P. Ramirez, R. J. Cava, and J. Krajewski, *Nature* 386, 156, (1997).

T3/32

Electronic Properties of CuFeS_2 Under Pressure Studied by Mössbauer Spectroscopy

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Transition-metal compounds, where an electron correlation plays an important role, exhibit a lot of interesting physical properties. At ambient pressure, CuFeS_2 is antiferromagnetic semiconductor with $T_N = 853 \text{ K}$. The ordered magnetic moment of the Fe atom is $3.8 \mu_B$, which is much smaller than that of the free Fe^{3+} ion. As indicated by X-ray diffraction measurement under pressure at room temperature, CuFeS_2 undergoes a structural phase transition at 6 GPa [1]. The conventional Mössbauer spectra on not-enriched in ^{57}Fe CuFeS_2 were measured under high pressure using a clamp-type DAC. Fluorinert was used as a pressure-transmitting medium. We discussed the electronic properties of CuFeS_2 under pressure by the ^{57}Fe conventional Mössbauer spectra. We have carried out the delay-time spectra of nuclear resonant forward scattering for CuFeS_2 under high pressure at SPring-8. The observed conventional Mössbauer spectra of CuFeS_2 consist of one magnetic subspectrum with no quadrupole interaction below 4 GPa whereas the spectra above 7 GPa are typical of a paramagnetic one with a quadrupole splitting.

The disappearance of magnetic hyperfine fields around 6.5 GPa has a good correspondence with the structural phase transition. The values of the center shift, δ_{CS} , below 6.5 GPa were evaluated to be about 0.2 mm/s which indicates that the Fe state is in trivalent. Around 6.5 GPa, a large enlargement in δ_{CS} of about 0.18 mm/s is observed, which shows a substantial change in the electronic structure of CuFeS_2 . We have used the powdered CuFeS_2 sample with enriched about 50 at.% ^{57}Fe to measure the NRFS spectra under pressure. Since CuFeS_2 is antiferromagnet, the magnetic hyperfine field at iron nuclei, the magnetic moment of iron atoms, is not easy to be aligned by a magnetic field. We have measured the delay-time spectra of NRFS in no external magnetic field condition. We observed quantum beats in the delay-time spectra owing to the constructive interference of photons emitted from the various nuclear levels in CuFeS_2 having different energies.

- [1] T. Tinoco *et al.*, *J. de Phys. C9*, 151, 1994

T3/33

Defects and Disorder in Magnetoresistive Double Perovskite A_2FeMoO_6 ($\text{A}=\text{Sr}, \text{Ba}$)

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A_2FeMoO_6 ($\text{A} = \text{Sr}, \text{Ba}$) is a double perovskite having an ordered ferrimagnetic structure of Fe and Mo magnetic superlattices. The Fe and Mo atoms are ordered on alternating, corner-shared octahedral sites, however, the ordered array can have imperfections that are dependent upon synthesis conditions. Mössbauer spectroscopy was used to examine the local magnetic and structural environment around the Fe atoms giving insight into what type of imperfections were present in the Fe magnetic superlattice. Transmission Mössbauer spectroscopy was performed on polycrystalline samples with varying degrees of disorder using magnetic fields of 0 and 7 Telsa. We were able to clearly resolve the iron nuclei with flipped magnetic moments (iron having a magnetic dipole moment parallel to the Mo magnetic dipoles), and associate the disorder in the structure with the different sites observed in the Mössbauer spectrum. The amount of disorder induced by various synthesis conditions was consistent with magnetization measurements that consistently show a lower than expected average magnetic dipole moment.

T3/34

Hyperfine Interactions of Sn-119 and Magnetic Transitions in RGa ($\text{R}=\text{Pr}, \text{Nd}, \text{Sm}, \text{Gd}, \text{Tb}, \text{Dy}, \text{Ho}, \text{Er}, \text{Tm}$).

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The microscopic properties of RGa ($\text{R}=\text{Pr}, \text{Nd}, \text{Sm}, \text{Gd}, \text{Tb}, \text{Dy}, \text{Ho}, \text{Er}, \text{Tm}$) ferromagnetic compounds were investigated over a wide temperature range (4.2- 300K) using the Sn-119 Mössbauer probe, occupying the Ga position. Only one component is observed in the resonance spectra for all RGa compounds except GdGa , for which two different components are observed with the same relative intensities and different magnitudes of the hyperfine magnetic field. In the compounds with the light rare earth ions, the transferred hyperfine fields are positive but those for the compounds with the heavy rare earth ions are negative. The magnitudes of the hyperfine fields B_{hf} change from 3 to 27 T, but are not proportional to the S_z spin moment projection of rare earth ions. The values of B_{hf}/S_z decrease linearly with increasing the rare earth atomic numbers. The analysis of the experimental results allowed to define the orientations of the principal axes of the electric field gradient tensor with respect to the crystallographic axes of the CrB crystal structure [1]. The V_{zz} component is parallel to the a axis, the V_{xx} component is parallel to the b axis, and asymmetry parameter $\eta=0.54(5)$. The magnitudes of the quadrupole interaction constant are the same for all compounds: $eQV_{zz}=1.15(2) \text{ mm/s}$. The temperature changes of quadrupolar shifts in the resonance spectra of NdGa and HoGa reveal a gradual turn of the Nd and Ho moments in the (a - c) planes. The temperature dependencies of the magnetic susceptibility confirm the presence of the spin reorientation in these compounds. The abnormal behavior of the transferred hyperfine fields in the spin orientation transition region is connected with the magnetic interaction anisotropy. The T_c of RGa compounds obtained from the temperature dependencies of the transferred hyperfine fields are in good agreement with the data [1].