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THE STUDY OF SUPEREXCHANGE INTERACTION OF ORDERED $Li_{0.5}Fe_{1.0}Rh_{1.5}O_4$

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$Li_{0.5}Fe_{1.0}Rh_{1.5}O_4$ has been made in air by the direct composition method. Magnetic properties of the sample were studied by Mössbauer technique without and in 60 kOe external field and SQUID magnetometer. X-ray diffraction patterns were analyzed by the Rietveld refinement method. The x-ray pattern of x = 1.50 is characterized by additional reflection (200) that is described by 1:1 ordered structure of Li, Fe at tetrahedral (A) site and can be assigned to the space group F43m. Figure 1 shows such ordered structure around Octahedral (B) site. The lattice constant (a_0) is 8.4348 Å. Mössbauer spectra were measured in 60 kOe external field parallel to the gamma-ray. The spectra at the liquid helium temperature show that the iron ions occupy both A and B sites. Two sites are in ferric states. The spectra measured from 4 K to the Néel temperature show the characteristic magnetic behavior which result from the ordered distribution of nearest neighbor ions of A site around Fe in B site. The Néel temperature has been determined 260 ± 3 K.

The temperature dependences of the magnetic hyperfine fields at the ^{57}Fe nuclei at two crystallographic iron sites are analyzed using the Néel theory of ferrimagnetism and Figure 2 shows the reduced magnetic hyperfine fields (H(T)/H(0)) for the A and B sites as functions of the reduced temperature (T/T_N). The inter-sublattice superexchange interaction is found to be antiferromagnetic with a strength of $J_{A\text{-}B} = -3.78\ k_B$ while the intrasublattice superexchange interactions are ferromagnetic with strengths of $J_{A\text{-}A} = 5.40\ k_B$ and $J_{B\text{-}B} = 7.39\ k_B$. The Debye temperatures of the tetrahedral and octahedral sites are determined to be 388 and 464 ± 3 K, respectively.

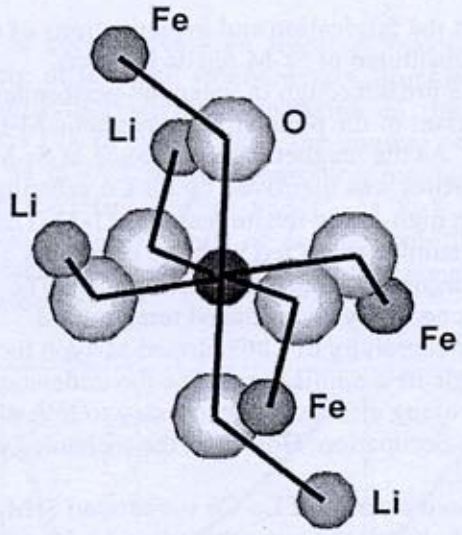

Figure 1. Ordered Cation Distribution at tetrahedral site around Fe at Octahedral (16e) site. : Fe ion at (4a) site, Li ion at (4c) site.

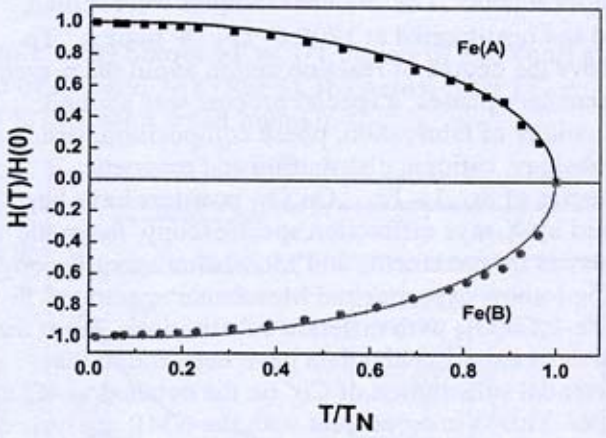

Figure 2. Reduced hyperfine field H(T)/H(0) of ferric ions at octahedral (B) and tetrahedral(A) sites as a function of reduced temperature (T/T_N).