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Program

MöSSBAUER STUDIES OF SUPEREXCHANGE INTERACTIONS IN $Ni_{0.5}Cu_{0.5}Fe_2O_4$

Woo Chul Kim, Sam Jin Kim, and Chul Sung Kim (Department of Physics, Kookmin University, Seoul 136-702, Korea)

$Ni_{0.5}Cu_{0.5}Fe_2O_4$ has been studied by Mössbauer spectroscopy and x-ray diffraction. The crystal is found to have a cubic spinel structure with the lattice constants a_0= 8.370 ± 0.005 Å. Mössbauer spectra of $Ni_{0.5}Cu_{0.5}Fe_2O_4$ were obtained at various absorber temperatures from 13 to 820 K. The iron ions at both A (tetrahedral) and B (octahedral) sites are found to be in ferric high-spin states. Its Néel temperature T_N is found to be 820 ± 3 K. The Debye temperatures for the A and B sites found to be be Θ_A = 417 ± 5 K and Θ_B = 331 ± 5 K, respectively. The temperature dependence of the magnetic hyperfine fields at ^{57}Fe nuclei at the tetrahedral (A) and octahedral (B) sites is analyzed by the Néel theory of ferrimagnetism. The intersublattice A-O-B and intrasublattice A-O-A superexchange interactions are found to be antiferromagnetic with their strength of $J_{A\text{-}B}$ = -25.8 k_B and $J_{A\text{-}A}$ = -10.5 k_B, respectively, while intrasublattice B-O-B superexchange interaction is ferromagnetic with its strength $J_{B\text{-}B}$ = 12.5 k_B.

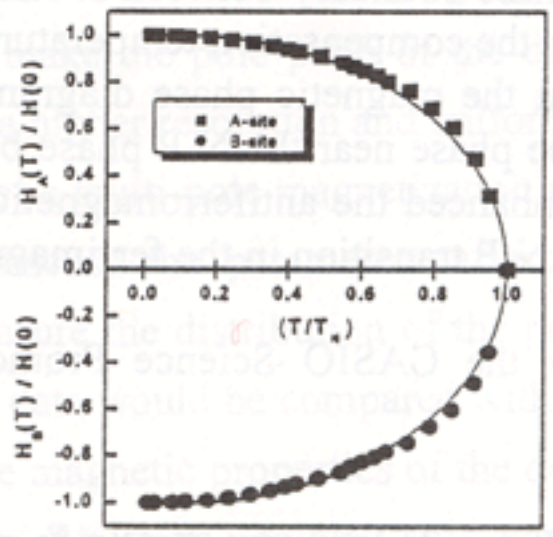

Figure 1. The reduced hyperfine field as a function of the reduced temperature T/T_N. (Solid circle and square represent reduced hyperfine fields of A and B site, respectively. Solid line represents theoretical value.)

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Name : Woo Chul Kim

Institution : Department of Physics, Kookmin University

Address : 861-1, Chongnung-dong, Songbuk-gu, Seoul 136-702, Korea

Phone : +82-2-910-4769

Fax : +82-2-910-4728