Journal of the Korean Physical Society, Vol. 32, No. 2, February 1998, pp. 151∼155

# Superexchange Interactions in $Cu_{0.5}Mg_{0.5}Fe_2O_4$

Sung Hyun YOON, Sam Jin KIM, Jung Soo YANG, Dong Hyun AN,
Hyun Hee LEE, Il Woong JUNG, Dong Hun KIM, Kun Uk KANG,
Kyung Seon BAEK and Hang Nam OAK

*Department of Physics, Yonsei University, Seoul 120-749*

Chul Sung KIM

*Department of Physics, Kookmin University, Seoul 136-702*

(Receive 21 October 1997)

$Cu_{0.5}Mg_{0.5}Fe_2O_4$ has been studied by Mössbauer spectroscopy and X-ray diffraction. The crystal structure is found to be a cubic spinel with the lattice constant $a_o = 8.3681 \pm 0.0005$ Å. The iron ions are in ferric states. The temperature dependences of the magnetic hyperfine fields of $^{57}$Fe nuclei at both the tetrahedral ($A$) and the octahedral ($B$) sites are analyzed by including a biquadratic term, $-2j_{ij}(\mathbf{S}_i \cdot \mathbf{S}_j)^2$, in addition to the usual bilinear one, $-2J_{ij}\mathbf{S}_i \cdot \mathbf{S}_j$, in the exchange energy. The dominant bilinear superexchange interaction is found to be antiferromagnetic, and its strength is $J_{A-B} = -16.17\ k_B$. The other two bilinear superexchange interactions are quite weak: $J_{A-A} = -0.97\ k_B$ and $J_{B-B} = 2.91\ k_B$. The strength of the biquadratic exchange interaction is also weak : $j_{A-B} = 0.727\ k_B$. The characteristic Debye temperatures of the tetrahedral and the octahedral sites are $499 \pm 5$ K and $361 \pm 5$ K, respectively.