

Mössbauer Studies of Superexchange Interactions in NiFe_2O_4

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NiFe_2O_4 has been studied using Mössbauer spectroscopy and X-ray diffraction. The crystal was found to have a inverse cubic spinel structure with the lattice constant $a_0=8.326\pm 0.003$ Å. Mössbauer spectra of NiFe_2O_4 was obtained at various absorber temperatures from 13 K to the Néel temperature. The Mössbauer spectra consisted of two sets of six lines corresponding to Fe^{+3} at the tetrahedral (A) and the octahedral (B) sites. The temperature dependence of the magnetic hyperfine fields at ^{57}Fe nuclei at the tetrahedral (A) and the octahedral (B) sites was analyzed by the Néel theory of ferrimagnetism. The intersublattice A-O-B and intrasublattice A-O-A superexchange interactions were found to be antiferromagnetic with strengths of $J_{A-B}=-25.0 k_B$ and $J_{A-A}=-4.0 k_B$, respectively, while the intrasublattice B-O-B superexchange interaction is ferromagnetic with a strength $J_{B-B}=4.2 k_B$.