Atomic Migration in $CoGa_xFe_{2-x}O_4$

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Abstract — Co-Ga ferrite has been studied with x-ray diffraction, vibrating sample magnetometer and Mössbauer spectroscopy. The crystal structure for this system is spinel, and lattice constants is in accord with Vegard's law. The Néel temperature decreases linearly with Ga concentration, suggesting the superexchange interaction Co-O-Fe link is stronger than that for the Ga-O-Fe link. Atomic migration of $CoGa_{0.4}Fe_{1.6}O_4$ starts near 350 K and increases rapidly with increasing temperature to such a degree that 73 % of the ferric ions as the A sites have moved to the B site by 700 K. The temperature dependence of the magnetic hyperfine field and magnetization of $CoGa_{0.4}Fe_{1.6}O_4$ is explained by the Néel theory of ferrimagnetism using three superexchange integrals : $J_{AB}=-11.5\,k_B$, $J_{AA}=9.8\,k_B$, $J_{BB}=21.3\,k_B$.

Index Terms — Co-Ga ferrite, Mössbauer spectroscopy, Atomic migration, superexchange integrals