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Atomic migration in $CoIn_{0.1}Fe_{1.9}O_4$

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Abstract

$CoIn_{0.1}Fe_{1.9}O_4$ ferrite has been studied with Mössbauer spectroscopy, and X-ray diffraction. The crystal structure is found to be a cubic spinel with the lattice constant $a_0 = 8.396 \pm 0.005$ Å. Mössbauer spectra of $CoIn_{0.1}Fe_{1.9}O_4$ were measured at various absorber temperatures of 17–825 K. Its Néel temperature T_N is found to be 765 K. The Mössbauer spectra consist of two six-line patterns corresponding to Fe^{3+} at the tetrahedral (A) and octahedral (B) sites. It is found that Debye temperature for the A and B sites of $CoIn_{0.1}Fe_{1.9}O_4$ is found to be $\Theta_A = 664 \pm 5$ K and $\Theta_B = 207 \pm 5$ K. The intensity ratio of the A to B patterns is found to increase at low temperatures with increasing temperature due to the large difference of Debye temperatures of the two sites and to decrease at high temperatures due to migration of Fe^{3+} ions from A to B sites. Atomic migration of $CoIn_{0.1}Fe_{1.9}O_4$ starts near 295 K and increases rapidly with increasing temperature to such a degree that 80% of the ferric ions at the A sites have moved over to the B sites by 700 K.

Keywords: Mössbauer spectroscopy; Ferrite; Atomic migration