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Crystallographic and Mössbauer studies of CoFeCrO_4

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Abstract

CoFeCrO_4 has been studied with X-ray diffraction, Mössbauer spectroscopy. The crystal structure is found to be a cubic spinel with the lattice constant $a_0 = 8.361 \pm 0.002 \text{ \AA}$. Mössbauer spectra of CoFeCrO_4 have been taken at various temperatures ranging from 16 to 350 K. The isomer shift indicates that the iron ions are ferric and located at the tetrahedral [A] sites. The Néel temperature is determined to be $T_N = 310 \text{ K}$. As the temperature increases toward T_N a systematic line broadening effect in the Mössbauer spectrum is observed and interpreted to originate from different temperature dependencies of the magnetic hyperfine fields at various iron sites. Also, by using binomial distribution equation we obtained the hyperfine fields of tetrahedral sites, $H_{\text{hf}}(\text{A}_3) = 525 \text{ kOe}$, $H_{\text{hf}}(\text{A}_4) = 516 \text{ kOe}$, $H_{\text{hf}}(\text{A}_5) = 508 \text{ kOe}$, $H_{\text{hf}}(\text{A}_6) = 499 \text{ kOe}$, $H_{\text{hf}}(\text{A}_7) = 490 \text{ kOe}$, $H_{\text{hf}}(\text{A}_8) = 481 \text{ kOe}$, $H_{\text{hf}}(\text{A}_9) = 472 \text{ kOe}$, $H_{\text{hf}}(\text{A}_{\text{avr}}) = 496 \text{ kOe}$ at 16 K. The average hyperfine field $H_{\text{hf}}(T)$ of the CoFeCrO_4 shows a temperature dependence of $[H_{\text{hf}}(T) - H_{\text{hf}}(0)]/H_{\text{hf}}(0) = -0.41 \times (T/T_N)^{3/2} - 0.14(T/T_N)^{5/2}$ for $T/T_N < 0.7$, indicative of spin-wave excitation. © 2002 Elsevier Science B.V. All rights reserved.

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