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Neutron diffraction and exchange interaction on $CoAl_xFe_{2-x}O_4$ $(x = 0.1, 0.2)$

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Abstract

Magnetic and structural properties of $CoAl_xFe_{2-x}O_4$ $(x = 0.1, 0.2)$ have been studied with X-ray, neutron diffraction, and Mössbauer spectroscopy. Neutron diffraction pattern at 10 K reveals a cubic spinel of Fd3m with ferrimagnetic order. Debye temperatures of the tetrahedral (A) and octahedral (B) site for $CoAl_{0.2}Fe_{1.8}O_4$ are found to be $\Theta_A = 709$ and $\Theta_B = 197$ K, respectively. The A–B and A–A superexchange interactions of $CoAl_{0.2}Fe_{1.8}O_4$ are antiferromagnetic with the strengths of $J_{A-B} = -21.3$ and $J_{A-A} = -19.6$ k_B, respectively, while the B–B interaction is ferromagnetic with a strength of $J_{B-B} = 4.8$ k_B.

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