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Crystallographic and magnetic structure in spinel system $\text{FeGa}_x\text{Cr}_{2-x}\text{S}_4$ by neutron diffraction

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Abstract

The samples of $\text{FeGa}_x\text{Cr}_{2-x}\text{S}_4$ ($x = 0.1, 0.3$) were prepared by solid reaction method. The crystallographic structure and the magnetic properties of the obtained compounds were investigated by X-ray and neutron powder diffraction, vibrating sample magnetometer (VSM), and Mössbauer spectroscopy. The Cr ions occupy 16(d) site exclusively, while mixed spinel behaviors are developed with increase of Ga ions. Finally, it induces a large quadrupole splitting in octahedral (16d) sites. Neutron diffraction on $\text{FeGa}_x\text{Cr}_{2-x}\text{S}_4$ above 10 K shows that there is no crystallographic distortion and reveals antiferromagnetic ordering. The magnetic moment of Fe^{2+} ($3.45 \mu_B$) are found to be aligned antiparallel to Cr^{3+} ($-2.89 \mu_B$), in the sample $x = 0.1$. Below the Néel temperature, magnetic peaks exist on the crystal diffraction peaks. It proves that spin structure of the same species are aligned parallel.

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