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# Neutron diffraction and Mössbauer study on $FeGa_xCr_{2-x}S_4$

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**Abstract** Ga doped sulphur spinel $FeGa_xCr_{2-x}S_4$ ($x = 0.1$ and 0.3) have been studied with X-ray, neutron diffraction, and Mössbauer spectroscopy. Rietveld refinement of X-ray, neutron diffraction, and Mössbauer spectroscopy lead to the conclusion that the samples are in inverse spinel type, where most Ga ions are present at octahedral site (B). The neutron diffractions on $FeGa_xCr_{2-x}S_4$ ($x = 0.1$) above 10 K show long range interaction behaviors and reveal a ferrimagnetic ordering, with the magnetic moment of $Fe^{2+}$($-3.45\ \mu_B$) aligned antiparallel to $Cr^{3+}$ ($+2.89\ \mu_B$) at 10 K. Fe ions migrate from the tetrahedral (A) site to the octahedral (B) site with an increase in Ga substitutions. The electric quadrupole splittings of the A and B sites in Mössbauer spectra give direct evidence that Ga ions stimulate an asymmetric charge distribution of Fe ions in the A site.

**Key words** neutron diffraction · magnetic structure · charge structure · cation distribution · Mössbauer spectroscopy