

## Mössbauer spectroscopy and neutron diffraction studies of the ferrimagnetic semiconductor on Ga-substituted $\text{FeGa}_x\text{Cr}_{2-x}\text{S}_4$

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The cation distribution and magnetic and transport properties of  $\text{FeGa}_x\text{Cr}_{2-x}\text{S}_4$  are studied. Rietveld refinement of x-ray diffraction and Mössbauer spectroscopy lead to the conclusion that the samples are in inverse spinel type, where Ga ion is present at tetrahedral site (*A*). The neutron diffraction on  $\text{FeGa}_x\text{Cr}_{2-x}\text{S}_4$  ( $x=0.1$ ) above 10 K shows that there is no crystallographic distortion and reveals an antiferromagnetic ordering, with the magnetic moment of  $\text{Fe}^{2+}(-3.45\mu_B)$  aligned antiparallel to  $\text{Cr}^{3+}(+2.89\mu_B)$  at 10 K. The resistance exhibits a strong dependence on Arrhenius model at temperature below 100 K, while it shows a strong correlation on small polaron model at temperature above 200 K. The electric quadrupole splittings of the *A* and *B* sites in Mössbauer spectra give a direct evidence that Ga ion stimulate asymmetric charge distribution of Fe ions in the *A* site. © 2005 American Institute of Physics. [DOI: 10.1063/1.1854051]