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Magnetic properties of Ga-substituted $FeGa_{0.1}Cr_{1.9}S_4$ with inverse spinel structure

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$FeGa_{0.1}Cr_{1.9}S_4$ has been studied with Mössbauer spectroscopy, X-ray diffraction, magnetization, and magnetoresistance (MR). The crystal structure is found to be a cubic spinel by Rietveld refinement of X-ray diffraction. The Mössbauer spectrum of $FeGa_{0.1}Cr_{1.9}S_4$ consists of two doublets at room temperature. The cation distribution is determined by Mössbauer spectroscopy, which reveals that the small amounts of Ga ions occupy tetrahedral sites and $FeGa_{0.1}Cr_{1.9}S_4$ has an inverse spinel type of structure. MR measurement of the sample shows that the metal–semiconductor transition occurs in the temperature range 77–300 K. The gap energies for regions I ($T < 150$ K) and II ($T > 200$ K) are 24.1 and 103.8 meV, respectively.