

Temperature dependent Mössbauer and neutron diffraction studies of $\text{Cu}_x\text{Fe}_{1-x}\text{Cr}_2\text{S}_4$ compounds

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Abstract The cation distribution and magnetic structure of $\text{Cu}_x\text{Fe}_{1-x}\text{Cr}_2\text{S}_4$ ($x=0.1, 0.2, 0.3, 0.4,$ and 0.5) has been studied by X-ray and neutron diffraction, vibrating sample magnetometer (VSM), and Mössbauer spectroscopy. The charge state of Fe is found to be ferrous (Fe^{2+}) for the $x=0.1$ sample; ferric (Fe^{3+}) for the $x=0.5$ sample; mixed state ($\text{Fe}^{2+}, \text{Fe}^{3+}$) for the $x=0.2, 0.3,$ and 0.4 samples. The Mössbauer spectra of the $x=0.1$ sample show asymmetric line broadening, which is considered to be due to the Jahn–Teller effect of Cu^{2+} ions, and a symmetrical six-line pattern is shown for the $x=0.5$ sample. The valence state of the Cu ions for the $x=0.1$ and 0.5 samples is found to be divalent and monovalent, respectively. The magnetic structure of the samples was determined to be a ferrimagnetic structure with antiparallel alignment of the Fe and Cr ion magnetic moments.

Key words neutron diffraction · Mössbauer spectroscopy · sulphur spinel