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Anomalous electron structure and magnetic properties in copper doped sulphur spinel

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Abstract

The Jahn–Teller distortional spinel compounds $\text{Fe}_{1-x}\text{Cu}_x\text{Cr}_2\text{S}_4$ ($x = 0.1, 0.5$) with conduction mechanism are investigated. The Mössbauer spectra were recorded from 13 K to room temperature. The asymmetric line broadening was observed for the $x = 0.1$ and considered to be the dynamic Jahn–Teller distortion. The unusual reduction of magnetic hyperfine field below 100 K may be explained in terms of cancellation effect between the mutually opposite orbital current field (H_L) and Fermi contact field (H_C). Mössbauer spectra identify that Fe ions occupy tetrahedral sites, the Cr ions occupy octahedral sites with a +3 valence in the $\text{Fe}_{1-x}\text{Cu}_x\text{Cr}_2\text{S}_4$ ($x = 0.1, 0.5$). The charge state of Fe ions are ferrous (Fe^{2+}) for the $x = 0.1$, while Fe ions are ferric (Fe^{3+}) for the $x = 0.5$.

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