Mössbauer studies of the magnetic phase transition in $Fe_{1-x}Zn_xCr_2S_4$

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The polycrystalline samples of Zn-doped $Fe_{1-x}Zn_xCr_2S_4$ ($0.1 \leqslant x \leqslant 0.9$) have been studied with x-ray diffraction, magnetization, and Mössbauer spectra measurements. Magnetic structure transforms from the ferromagnetic ($0.1 \leqslant x \leqslant 0.5$) to the antiferromagnetic phase ($0.7 \leqslant x \leqslant 0.9$). The Mössbauer spectra of $Fe_{1-x}Zn_xCr_2S_4$ show asymmetrical eight lines due to electric quadrupole interactions below 10 K. The magnetic hyperfine field and electric quadrupole interaction for the sample $x=0.5$ at 4.2 K have been fitted with Mössbauer hyperfine parameters of $H_{hf}=116$ kOe, $\theta=27°$, $\varphi=0°$, $\eta=0.60$, $E_Q=2.28$ mm/s, and $R=2.9$. We have observed that the magnetic hyperfine field H_{hf} decreases with increasing Zn concentration in the ferrimagnetic range ($0.1 \leqslant x \leqslant 0.5$) at 4.2 K, while it increases in the antiferromagnetic region ($0.7 \leqslant x \leqslant 0.9$). This indicates the changes in the orbital current field contribution depending on Zn concentration in $Fe_{1-x}Zn_xCr_2S_4$.
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