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Mössbauer Studies of Fe-Zn Sulphur Spinels

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The fascinating ground state for Cr-based chalcogenide spinels are interested for strong-correlation between the charge, spin, and orbital degree of freedom [1]. Very recently, spin-driven phonon splitting in bond-frustrated ZnCr$_2$S$_4$ has been reported [2]. Now, whether frustration mechanism on Cr-based spinels isoriginated from the geometrical structure or quenching of magnetic exchange interaction is not resolved, yet. In this report, we present a detailed investigation of Fe-Zn-Cr spinels.

The polycrystalline sample of Zn doped Fe$_{1-x}$Zn$_x$Cr$_2$S$_4$($x=0.1, 0.3$) were prepared by solid state reaction. The crystallographic and magnetic properties of Fe$_{1-x}$Zn$_x$Cr$_2$S$_4$($x=0.1, 0.3$) have been studied by x-ray diffractometer(XRD), vibrating sample magnetometer(VSM) and Mössbauer spectroscopy measurement. The crystal structure was determined by the normal cubic spinel of space group $Fd3m$ and the lattice constants($x=0.1, 0.3$) were $a_0 = 9.9967$ Å and $a_0 = 9.9931$ Å, respectively. The specific cusp like patterns were observed in magnetization curves (ZFC:zero field cooling) under 100 Oe applied field. With increasing Zn concentration from $x=0.1$ to $x=0.3$, the cusp like point shifted from 77 to 86 K. The Néel temperature of FeCr2S4 was reported to be 170 K [3]. It was diminished to 153 K($x=0.1$), 135 K($x=0.3$) with Zn substitution concentration. This result is interpreted that the A-B superexchange interaction of the spinel with the formula AB2S4 was decreased by decrease of Fe ions of A site.

REFERENCES