PE08

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 $ZnCr_2S_4$ 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 $Fe_{1-x}Zn_xCr_2S_4$(x=0.1, 0.3) were prepared by solid state reaction. The crystallographic and magnetic properties of $Fe_{1-x}Zn_xCr_2S_4$(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) withZn substitution concentration. This result is interpreted that the A-B superexchange interaction of the spinel with the fomula AB2S4 was decreased by decrease of Fe ions of A site.

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PE09

Mössbauer Study of Electric Quadrupole-driven Anisotropic Interaction for FeV_2Se_4

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Recently chalcogenides spinel are interested for various mangtic properties. Colossal magnetocapacitve multiferroic properties have been reported for Cd-Cr spinel [1]. Orbital freezing and orbital glass state in Fe-Cr spinel were studied by specific heat measurement[2]. Incommemsurate disordered spin-dimer state in charge ordered system are shown Cu-Ir sulphur spinel [3]. Also strongly correlated spin-orbit coupling was suggested for ferrimagnetic selenide compounds [4]. Various kinds physical phenomena are reported on chalcogenides spinels. In this report, we present microscopic interaction mechanism on FeV_2Se_4.

FeV_2Se_4 has been studied with Mössbauer spectroscopy, XRD (x-ray diffraction), and magnetization measurments. Crystallographic structure, cation ditribution, anion positions were determined by Rietveld refinement of Fullprof program. Crystal symmetry is found to be monoclinic space group of *I2/m* [Fe (2a); Cr(4i); S(4i(u,0,w)] with its lattice constants, a_0 = 6.152Å b_0 = 3.458Å and c_0 = 11.726 Å.

Mössbauer sepctra of FeV_2Se_4 show severely distorted asymmetric 8-line shape below 85 K, denoting large orbital contribution. While, it shows a quadrupole doublet above 85 K, of which value decreases with increase of temperature. It is noticeable that, in the temperature region 85 K $\leq$ T $\leq$ 300 K, the ratio of intensity of the two line $R_q = A_1/A_2$ increases rapidly from 1 to 1.30, where A_1, A_2 correspond to Mössbauer absorption area of the quadrupole splitting for lower and higher energies, respectively. We interpret that it is closely related to the anisotropic atomic vibration for an iron atom in FeV_2Se_4. Also, it accords with the result of XRD refinement, slightly distorted local environment of the Se ions along c-axis.

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