

PE08

Mössbauer Studies of Fe-Zn Sulphur Spinel

Sung Hwan Bae, Sam Jin Kim, and Chul Sung Kim*

Department of Physics, Kookmin University, Seoul 136-702, Korea

*Corresponding author: eskim@phys.kookmin.ac.kr. Phone: +82 2 910 4752. Fax: +82 2 910 4728

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 is originated 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 $Fd\bar{3}m$ and the lattice constants ($a=0.1, 0.3$) were $a_0 = 9.9967 \text{ \AA}$ and $a_0 = 9.9931 \text{ \AA}$, 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 $FeCr_2S_4$ 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 AB_2S_4 was decreased by decrease of Fe ions of A site.

REFERENCES

[1] K. Ohgushi, T. Ogasawara, Y. Okimoto, S. Miyasaka, and Y. Tokura. Phys. Rev. B 72, 155114 (2005).
 [2] J. Hemberger, T. Rudolf, H.-A. Krig von Nidda, F. Mayr, A. Pimenov, V. Tsurkan, and A. Loidl. Phys. Rev. Lett. 97, 087204 (2006).
 [3] A. P. Ramirez, R. J. Cava, and J. Krajewski, Nature 386, 156 (1997).

PE09

Mössbauer Study of Electric Quadrupole-driven Anisotropic Interaction for FeV_2Se_4

Sam Jin Kim¹, Ju Hong Kang¹, Bae Soon Son¹, Jungbum Yoon²,
 Myung-Hwa Jung², and Chul Sung Kim^{1*}

¹Department of Physics, Kookmin University, Seoul 136-702, Korea

²Quantum Material Research Team, Korea Basic Science Institute, Daejeon 305-333, South Korea

*Corresponding author: eskim@kookmin.ac.kr. Phone: +82 2 910 4752. Fax: +82 2 910 5170

Recently chalcogenides spinel are interested for various magnetic properties. Colossal magnetocapacitive 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]. Incommensurate 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 measurements. Crystallographic structure, cation distribution, 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(4b); S(4i,u,0,w)] with its lattice constants, $a_0 = 6.152 \text{ \AA}$, $b_0 = 3.458 \text{ \AA}$ and $c_0 = 11.726 \text{ \AA}$.

Mössbauer spectra 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 $85 \text{ K} \leq T \leq 300 \text{ K}$, the ratio of intensity of the two line $R_0 = A_1/A_2$ 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.

REFERENCES

[1] J. Hemberger, P. Lunkenheimer, R. Fichtl, H. A. Krig von Nidda, V. Tsurkan, and A. Loidl. Nature, 434, 364 (2005).
 [2] R. Fichtl, V. Tsurkan, P. Lunkenheimer, J. Hemberger, V. Fritsch, H. A. Krig von Nidda, E. W. Scheidt, and A. Loidl. Phys. Rev. Lett. 94, 027601 (2005).
 [3] V. Kiryukhin, Y. Horibe, Y. S. Hor, H. J. Noh, S.-W. Cheong, and C. H. Chen. Phys. Rev. Lett. 97, 225503 (2006).
 [4] T. Ogasawara, K. Ohgushi, Y. Tomioka, K. S. Takahashi, H. Okamoto, M. Kawasaki, and Y. Tokura. Phys. Rev. Lett. 94, 087202 (2005).