Phase Transition and Magnetic Transport Properties for Single Crystal of (Ca_{0.42}Sr_{0.58})₃Ru₂O₇

Qing Ji¹, Ming Fu¹, Jianjian Ge¹, Bin Qian^{1,2}, Zhe Qu², Z.Q. Mao², and X.S. Wu¹

¹National Lab Nanjing Microstructures, Key Lab of Solid State Microstructures, Department of Physics, Nanjing University, Nanjing 210093, China
²Physics Department, Tulane University, New Orleans, Louisiana 70118, USA

Double layered Ca doped ruthenates $(Ca_{1,x}Sr_x)_3Ru_2O_7$ (A₃M₂O₇-type structure with A=alkaline metal, and M=transition metal; CSRO) system contains abundant physics, which relates to its novel structural phase transition. Ionic decreasing in A-site may induce the compressing in RuO₆ Octahedron in CSRO. The distortion around RuO₆ octahedron plays the critical role on phase transiton. There are two types of distortions containing in RuO₆ octahedron. One is the rotation of oxygen atoms in RuO₂ plane (or ab plane in unit cell), which enhances the ferromagnetic coupling (FM) among Ru^{3+} with 42% Ca replacing for Sr in CSRO. Another one results from the movement of vertex oxygen atoms in RuO₆ octahedron (tilting along c axis), which makes the in-plane ferromagnetic ordering vary to antiferromagnetic ordering (AFM). Study on the subtle structural variations is necessary to understand the physical properties in CSRO. In the present, detailed structural variations are obtained from Rietveld refinements from the single crystal after grinding using the X-ray powder diffraction data. Two phases of Sr₃Ru₂O₇-type (Bbcb symmetry) and Ca₃Ru₂O₇-type (Bb2₁m) are observed in low temperature, which varying with temperature. The lattice constants dependence of temperature is calculated. The oxygen rotation in RuO₆ is about 18.8°, while the titling angle is also zero from the refinements. Magnetization measurements show that the magnetic moment along a-axis is the same as that along b-axis. At T~10 K, the DC M (T) shows an irreversibility behavior, while the AC suscibility χ (T) is frequency independent, which tells us there is no spin glass state at this temperature but the antiferromagnetic fluctuation still exists. The in-plane and out of plane resistivities dependence of temperature shows that $\rho_c - \rho_{ab}$, and a kink relation in ρ_{ab} -T curve, which corresponds to the structural variations at low temperature.

BS23

Magnetocaloric Effects of Zn-Co Mixed Ferrites

Seung-Iel Park¹, Sung Wook Hyun¹, Jae Yun Park², and Chul Sung Kim^{1*}

¹Department of Physics, Kookmin University, Seoul 136-702, Korea ²Department of Materials Science and Engineering, University of Inchon, Inchon 402-749, Korea

*Corresponding author: Chul Sung Kim, e-mail: cskim@phys.kookmin.ac.kr

Many researchers have been studied to the magnetic refrigeration[1-3] used the metal based magnetic materials. Also the magnetic oxide based materials have actively studied. Polycrystalline samples of the $Zn_{1-x}Co_xFe_2O_4$ (0.25 $\leq x \leq 0.35$) were prepared with 1100°C sintering by a solid state reaction method. The x-ray diffraction patterns of Zn-Co mixed ferrites were indicated a cubic spinel structure at room temperature. As the Cobalt ion increased, the lattice constant a_0 is decreased from 8.435 to 8.431 Å, while the magnetic Néel temperature is increased. The magnetic Néel temperature is determined the do/dT curve for the zero field cooled curve under external field of 100 Oe. Figure 1 show the $Zn_{1,x}Co_xFe_2O_4$ (0.25 $\leq x \leq 0.35$) of the magnetic hysteresis curves at room temperature. As the Zn-Co mixed ferrites, the maximum magnetocaloric effects show around the utmost limits for the $d\sigma/dT$ curve. We measured various temperature ranges of the magnetic hysteresis curves around the the utmost limits for the $d\sigma/dT$ curve. The magnetocaloric effect for samples was calculated by used the numerical formula (1).[2]



Fig. 1. The $Zn_{1-x}Co_xFe_2O_4$ (0.25 $\leq x\leq 0.35$) of the magnetic hysteresis curves at room temperature.

 $\Delta S_m(T,\Delta S) = \int_0^H \left(\frac{\partial M}{\partial T}\right)_H dH$

 ΔS_m is the magnetic entropy variation value.

REFERENCES

[1] J. Glanz, Science 279, 2045 (1998). F. R. de Buschow et al., Nature 415, 150 (2002).

(1)

- [2] V. Provenzano et al., Nature 429, 853 (2004).
- [3] S. Stadler et al., Appl. Phys. Lett. 88, 192511 (2006).