Magnetic Properties of Perovskite $La_3Co_2TaO_9$ Compound

Bingzhi Jiang[1], Wen-Zhe Nan [2*], Kyeongsup Kim[2], Seong-Cho Yu[2]
[1]Department of Physics, Yanbian University, Yanji, Jilin 133002, PR China
[2]Department of Physics, Chungbuk National University, Cheongju 361-763, Korea

1. Introduction

Perovskites and double perovskites are very attractive because of the interest in applications and fundamental areas. The general formula of a simple perovskite is ABO_3 and is a highly flexible structure. The perovskites have historically proved themselves to be extremely robust structures that can accommodate a wide variety of cations on the A and B sites. Recently, Fuertes et al were prepared new type double perovskite of $La_3Co_2MO_9$ (M = Ta,Nb,Sb) and conclude that the M = Ta, Nb have ferromagnetic and M = Sb has a antiferromagnetic behavior. Therefore, it would be very interesting to study the magnetic properties of this kind of compound. In this paper we studied the magnetic behavior of $La_3Co_2TaO_9$ double perovskite.

2. Experiments

Polycrystalline samples are prepared by the solid state reaction method using stoichiometric mixture of high purity La_2O_3(3N), CoO(3N) and Ta_2O_5(3N). The mixture was heated in alumina crucibles in air atmosphere at temperature 900°C for 30 hours after cooling down to room temperature and sintering with 1320°C and 1400°C for 24 hours. Room temperature X-ray diffraction(XRD) data were collected using diffractometer with a step size of 0.02° and Cu Kα radiation. The temperature dependence of DC magnetization data was measured by a vibrating sample magnetometer(VSM) from 10 to 300 K with 50 Oe applied magnetic field.

3. Results

Fig.1 shows the temperature dependence of magnetization and inverse susceptibility. This results are coincide with $La_3Co_2SbO_9$ which is magnetic frustrated antiferro-magnetism. The reciprocal susceptibility is linear fitted between 100 and 150 K temperature range with a Curie-Weiss law, $x=C/(T-\theta)$. The values obtained from the fit are: θ = *65 K* and C_M = 3.131 emu K/mol Oe. The effective magnetic moment obtained from the C_M is 5 μ_B by using $\mu_{eff} = [8C_M]^{1/2}$. This value is nearly same with experimental magnetic moment of 4.8 μ_B for the Co^{2+}. The positive sign of θ is indicates the presence of ferrimagnetic interaction in this compound.

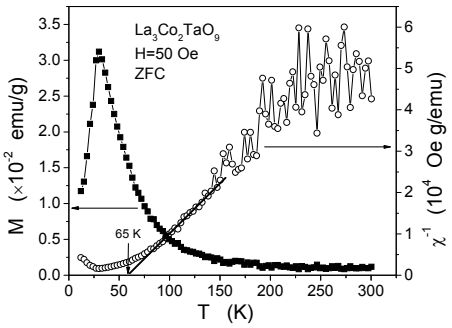

Fig.1 Magnetization and inverse susceptibility versus temperature

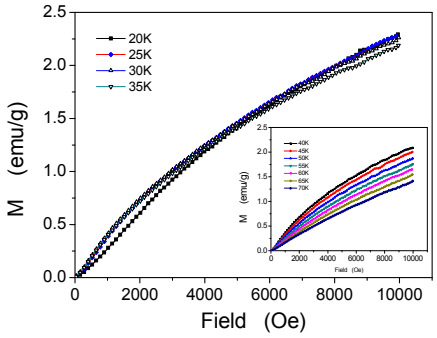

Fig. 2 magnetization vs. applied field with temperature

Fig. 2 shows the field dependence of magnetization of 20 K, 25 K. 30 K and 35 K. The values are nearly same at more than 5000 Oe applied field. As can be seen in insert figure 2, after Neel temperature(above 35 K) the high field magnetization is gradually decreased with temperature. This is one evidence this system have antiferromagnetic behavior. The coercivity force and residual magnetization as a function of temperature are dramatically decrease to Neel temperature of 30 K after that the coercivity force maintain almost constant and residual magnetization is gradually decrease. The hysteresis behavior at higher than Neel temperature and positive Curie-Weiss temperature imply this compound has ferrimagnetic behavior.

4. Conclusion

We have studied the magnetic properties of double Perovskite $La_3Co_2TaO_9$. The Neel temperature is 30 K and at high temperature obey Curie-Weiss law. The coercivity and residual magnetization are rapidly decrease in lower than Neel temperature and the coercivity is nearly constant and residual magnetization is gradually decrease in higher than Neel temperature. Our results that show that this system have antiferromagnetic with some ferrimagnetic interaction.

References

[1] D. G. Franco, V. C. Fuertes, M. C. Blanco, M. T. Fernandez-Diaz, R. D. Sanchez, R. E. Carbonio, J. Solid State Chem., **194,** 385 (2012)

[2] C. R. Wiebe, J. E. Greedan, G. M. Luke, J. S. Gardner, Phys. Rev. B., **65**, 144413 (2002)

[3] V. C. Fuertes, M. C. Blanco, D. G. Franco, J. M. De Paoli, E. V. Pannunzio Miner, R. D. Sanchez, M. T. Fernandez-Diaz, R. E. Carbonio, Physica B, **404**, 2717 (2009)

[4] V. C. Fuertes, M. C. Blanco, D. G. Franco, J. M. De Paoli, R. D. Sanchez, r. E. Carbonio, Mater. Res. Bull. **46**(2011),62

[5] S. Aasland et al. Solid State Commun.**101,** 187 (1997)

[6] J. Yang, Y. P. Lee, Y. Li, J. Appl. Phys, **102**, 033913 (2007)