The 8th Joint MMM-Intermag Conference

ABSTRACTS

SAN ANTONIO, TEXAS ▪ JANUARY 7-11, 2001

THURSDAY AFTERNOON, 11 JANUARY 2001 SALON C, 1:00 TO 5:00

Session HW
OTHER MAGNETORESISTIVE OXIDES (POSTER SESSION)

Jim Rhyne, Chair
University of Missouri-Columbia, Department of Physics, Columbia, MO 65211

Contributed Papers

HW-01. Preparation and magnetic properties of double perovskite A_2FeMoO_6(A=Ca,Sr,Ba). W. H. Song, J. M. Dai, S. G. Wang, S. L. Ye, K. Y. Wang, *Y. P. Sun* (Inst. of Solid State Phys., Academia Sinica, LIFD, Kexue Rd. 10, Dongpu Rd., Hefei, Anhui, 230031, CN), and *Y. P. Sun* (Univ. of Science and Technol. of China, Structure Res. Lab., Jinzhai Rd. 96, Hefei, Anhui, 230026, CN)

Polycrystalline double perovskites A_2FeMoO_6 (A = Ca, Sr, Ba) with nanometer-scale grain size have been synthesized using a sol-gel method. The grain size of the samples is controlled from tens to hundreds of nanometer by sintering at different temperatures. The phase purity and the crystal structure of the samples are analyzed by x-ray powder diffraction measurements. The electrical transport and magnetic properties are also measured in this paper. In comparison with the large grain samples, the nanometer-scale grain samples have different magnetic properties, such as larger magnetoresistance, lower magnetic transition temperature and smaller saturation magnetization, which can be explained in terms of size effect.

HW-02. Anisotropic hyperfine field fluctuation in Sr2FeMoO6. *Sung Baek Kim*, Key Taeck Park, and Chul Sung Kim (Kookmin Univ., Dept. of Phys., 861-1, Sungbu-Ku, Seoul, 136-702, KR)

The double perovskite Sr_2FeMoO_6 has been studied by Mössbauer technique, neutron and x-ray diffraction. The structure is found to be tetragonal with lattice constants a_0 = 5.5729 Å and c_0 = 7.9077 Å. Mössbauer spectra and neutron diffraction measurements of the Sr_2FeMoO_6 have been taken at various temperatures ranging from 15 to 425 K. The low-field MR magnitude($\Delta\rho/\rho_0$) at 500 Oe was 3.1 % and 1.8 %, at 77 K and 300 K. As the temperature increases toward to the Curie temperature, T_C = 425 K, Mössbauer spectra line broadening and 1, 6 and 3, 4 line-width difference appear to suggest anisotropic hyperfine field fluctuation[1],[2]. Mössbauer spectra indicated an anisotropic field fluctuation of +H (P_+ = 0.85) was great than -H (P_- = 0.15). We calculated frequency factor and anisotropy energy to be 9.6 $\Gamma/\hbar$ and 96 erg/cm^3, respectively, using the relatively accurate data for T = 260 K which is associated with the large line broadening.

[1] D. G. Rancourt, J. Magn. Magn. Magn. **51**, 83 (1985).
[2] C. S. Kim, IEEE Trans. On Magn. **35** (5), 2868 (1999).

HW-03. Sr2FeMoO6: A new familly of half-metallic ferromagnets. Synthesis and characterization issues. *Josep Fontcuberta*, J. Navarro, Ll. Balcells, M. Bibes, F. Sandiumenge, B. Martinez (Institut de Ciencia de Mater. de Barcelona, Magnetic and Superconducting Mater., Campus U.A.B., Bellaterra, Barcelona, 08193, ES), and A. Roig (Institut de Ciencia de Mater. de Barcelona, Cristal.lografia i Quimica de l'Estat Solid, Campus U.A.B., Bellaterra, Barcelona, 08193, ES)

Oxides of the type A2BB'O6 where A is an alkaline earth (A=Sr, Ca, Ba) and B, B' are heterovalent transition metals such as B=Fe, Cr,.. and B'= Mo, W, Re,…, are receiving a renewed great deal of attention. This is motivated by the recent report that Sr2FeMoO6 is a half-metallic ferromagnet with a high Curie temperature. The structure is built up by a rock salt ordering of perovskite blocks and the properties of the material are thought to critically depend on this ordering. Sr2FeMoO6 is believed to be ferrimagnetic-like, i.e. the B and B' sublattice are antiferromagnetically coupled. The role of the synthesis conditions on the cationic Fe/Mo ordering in Sr2FeMoO6 double perovskite and its consequences on the magnetotransport properties will be addressed. We will show that this ordering can be controlled and varied systematically. We have experimentally found that it lowers the saturation magnetization. In addition a high-field differential susceptibility (chi-d) develops. The nature of the magnetic coupling (superexchange vs double exchange) and its relation to chi-d will be addressed. The correlation among the antisite defects, i.e. the Fe ions located at the Mo sites, and the magnetic and transport properties will be discussed. Mössbauer analysis reveals the existence of two distinguishable Fe sites in agreement with the P4/mmm symmetry obtained from structural analysis by X-ray diffraction and a charge density at the Fem+ ions significantly larger than 3d5. These observations suggest a fluctuating valence state of Fe3+/2+ ions and thus a contribution to the spin-down conduction band. The magnetic properties in the paramagnetic state up to 700K have also been deeply studied. It turns out that the effective magnetic moment is substantially larger (about 6 mB) that expected (4 mB). We shall disuse these results on the basis the current understanding of the electronic band structure.

HW-04. Effect of grain size on MR in Ba_2FeMoO_6. *Hauk Han*, Byung Jin Han, Jung Soo Park, Bo Wha Lee (Hankuk Univ. of Foreign Studies, physics, Yongin, Kyungki, 449-791, KR), Sam Jin Kim, and Chul Sung Kim (Kookmin Univ., physics, Songbuk, Seoul, 136-702, KR)

The effect of grain size on magnetoresistance(MR), magnetization, and electrical resistivity in double perovskite $Ba_2FeMoO_6(BFMO)$ has been investigated. BFMO has been prepared by the conventional solid state reaction in a stream of $5\%H_2$ at 1100C with various annealing times. The crystal structure and physical properties of the samples were examined by X−ray power diffraction, magnetization M(T), and electrical resistivity $\rho(T)$ measurements. The x−ray power diffraction pattern for polycrystalline BFMO shows a clean single phase without detectable secondary phases. The fact that superlattice lines are observed in X−ray diffraction pattern suggests the high degree of ordering of Fe and Mo in BFMO. The size of grain increases with increasing of annealing time. The $\rho(T)$ and MR depend on the grain size. A longer annealing time lowers the $\rho(T)$ and reduces the MR value. However, magnetization is not sensitive to the grain size. In spite of different annealing conditions, the $\rho(T)$ shows metallic behavior below the ferromagnetic transition temperature. Low magnetic field applied to the sample considerably reduces the resistivity over the whole temperature. BFMO exhibits a sharp low−field MR. The magnitude of negative MR for the sample annealed for 24 h is as large as 27 and 5% with the magnetic field of 0.8T at 12 and 300K, respectively. The observed MR features do not show any hysteresis behavior related with ferromagnetic properties. A quantitative analysis of the observed MR in the samples reveals that the MR is proportional to the square function of (M/Ms) at small magnetization region. This correlation shows the MR in BFMO is dominated by transport between grain boundaries that is sensitive to an applied magnetic field.