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ABSTRACTS

thickness t increases. As the temperature decreases, the dip in GMR profile disappears, meaning that implantation effect becomes negligible irrespective of pinned layer thickness. As a whole, the MR ratio increases with decreasing temperature. The GMR profiles show the sharp increase of resistivity near zero magnetic field in spin-valve type at low temperature of 50 K. The GMR profiles were analyzed by using the double domain model [1] to give a good fitting with the measured profiles. The fitting results indicate that the N-ion implantation does not affect on the magnetic characteristics in free layer, but causes the significant change of intrinsic magnetic properties of anisotropy constant and exchange coupling field in pinned layer.

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4T-24. CORRELATIONS BETWEEN SPIN ORIENTATION, STRUCTURAL DISTORTIONS, AND CONDUCTIVITY FOR MANGANITES. B. Dabrowski, X. Xiong, Z. Bukowski, O. Chmaissem, J. Mais, C.W. Kimball (Argonne National Laboratory, Materials Science Division, 9700 S. Cass Ave., Argonne, IL, 60439, US) and J.D. Jorgensen, S. Short (Argonne National Laboratory, Materials Science Division, 223, 9700 S. Cass Ave., Argonne, IL, 60439, US)

Magnetic interactions in Perovskite manganites are described in terms of the interplay between super- and double-exchange that leads to competition between antiferromagnetic-insulating and ferromagnetic-metallic ground states. Colossal magnetoresistive effect (CMR) observed near the Curie temperature, Tc, have been recently shown to arise, in addition to magnetic interactions, from strong electron-phonon couplings of the Jahn-Teller (JT) or "breathing-mode" (CO) types. These interactions produce local structural distortions and cause charge localization. Strong coupling between magnetic and electron-phonon interactions, proximity of several structural transitions, and tendency to form defects result in a very rich structure-property relationships for $La_{1-x}A_xMnO_{3+d}$ (A = Ca, Sr, Ba) materials. We have performed comprehensive study of the synthesis conditions and have determined intrinsic phase-diagrams for stoichiometric compounds as a function of temperature and composition. For lightly substituted $La_{1-x}Sr_xMnO_3$ materials above Tc the crystallographic structure is orthorhombic (O'), characterized by coherent JT-orbital ordering of the long, = 2.1, and short, = 1.9 Å, Mn-O bonds. For x * 0.12, an orthorhombic phase (O*) is observed with considerably smaller coherent JT-orbital ordering and increased incoherent distortions. At higher Sr substitution level, x > 0.17, the structure is rhombohedral (R) with no coherent and large incoherent JT-orbital ordering. For $La_{1-x}Ca_xMnO_3$ the O'/O* transition at room temperature appears near x = 0.15. Upon substitution, the canted antiferromagnetic insulator transforms to a ferromagnetic insulator and to a ferromagnetic metal. Lowering temperatures below the ferromagnetic transition results in distinct modifications of the structural phases and concurrent changes of the physical properties. Development of the ferromagnetic order suppresses coherent JT-distortions for the O' phase and incoherent distortions for the O* and R phases. The orientation of the ferromagnetic spin moments is mainly pointing along the b axis when coherent JT-distortion is large and aligns almost along the c axis as coherent JT-distortion diminishes. As a result the metallic state occurs below the Curie temperature only when both coherent and incoherent JT-distortions are suppressed and the ferromagnetic spin moments are oriented along the c axis. The insulating phase is formed above T_c due to enhanced spin scattering in the paramagnetic state and polaronic JT-distortions that induce charge localization. Knowledge of the phase-diagrams has been used to design compounds with improved low-field CMR effect at room temperature.

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4T-26. ROOM TEMPERATURE MAGNETORESISTANCE IN Ba_2FeMoO_6. J. S. Park, Y. J. Kim, J. Y. Kim, B. J. Han, B. W. Lee (Hankuk University of Foreign Studies, Physics, Yongin, Kyungki, 449-791, South Korea)

Room temperature magnetoresistance effect has been observed for polycrystalline double perovskite Ba_2FeMoO_6, which has been prepared by solid-state reaction in a stream of 5% H_2/Ar. The temperature dependence of resistivity shows metallic behavior below the ferromagnetic transition temperature of 312K. The magnitude of negative magnetoresistance with the magnetic field of 0.8T at 12 and 300K is as large as 27 and 5%, respectively. The observed magnetoresistance features do not show any hysteresis behavior related with ferromagnetic properties.

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4T-27. MAGNETIC ORDERING AND MAGNETORESISTANCE OF LAYERED PEROVSKITE $Nd_{1+x}Sr_{2-x}Mn_2O_7$. Masayuki Tsukamoto, Kiyotaka Miyoshi, Kenji Fujiwara, Jun Takeuchi (Shimane University, Department of Material Science, 1060 Nishikawatsu, Matsue, Shimane, 690-8504, Japan)

Magnetic and transport properties of Layered Perovskite $Nd_{1+x}Sr_{2-x}Mn_2O_7$ crystals grown by the floating zone method have been studied. The material with x=0 is insulating and antiferromagnetic with spin-glass-like behavior at low temperature. On increasing x, the antiferromagnetic behavior is suppressed and ferromagnetic behavior appears, and the resistivity decreases. The material with x=0.4 has a resistivity maximum showing a metal-insulator transition near the ferromagnetic transition temperature. The magnetic field of 7T causes the negative magnetoresistance of 54% there. The material x=0.2 is interesting because it shows successive magnetic transitions at T_{c1}=240 K and T_{c2}=100 K. The magnetization starts to increase gradually below T_{c1}, probably due to a two dimensional ferromagnetic alignment. The magnetization decreases having a maximum around T_{c2} under an applied magnetic field of 0.01T and that increases having a shoulder around T_{c2} under 0.1T, both of which have a large deference between under zero-field-cooled and field-cooled conditions. Glass-like behavior below T_{c2} has been well confirmed by the linear and nonlinear AC susceptibility measurements. The resistivity increases steeply below T_{c2} and the magnetic field of 7T causes the colossal magnetoresistance of 97.5% there. These results are ascribed to the frustration of random competing double-exchange ferromagnetic and super-exchange antiferromagnetic interactions with the anisotropy originating from layered structure.

4T-28. STRESS-INDUCED ENHANCEMENT OF MAGNETORESISTANCE IN $La_{0.75}Ca_{0.25}MnO_3$ THIN FILMS GROWN ON SI(100) SUBSTRATES. Jong Cheol Lee, Dong Gyun You, Sang Yub Ie, Kwang Ho Jeong (Yonsei University, Department of Physics, 134 Shinchon-dong Seodaemu-gu, Seoul, 120-749, South Korea) and Sam Jin Kim, Chul Sung Kim (Kookmin University, Department of Physics, 861-1 Chongnung-dong Songbuk-ku, Seoul, 136-702, South Korea)

The enhancement of magnetoresistance (MR) in $La_{0.75}Ca_{0.25}MnO_3$ perovskite thin films, grown on Si (100) substrates by RF magnetron sputtering, was studied. All of as-deposited films were annealed at 800°C for 30min in air. Structures, magnetic properties and compositions of La-Ca-Mn-O films have been studied with X-ray diffraction (XRD), Rutherford back-scattering spectroscopy (RBS), X-ray photoemission spectroscopy (XPS), vibrating sample magnetometer and SQUID magnetometer. The films were polycrystalline with (100) and (110) orientations. The lattice constants of films were reduced as much as 0.9% compared to the one of the sputtering target, which proves that the compressive stress on films was imposed by Si substrate. It is found that the MR ratios ($\frac{\Delta\rho}{\rho_0}$) of films are 0.33, 0.29 and 0.27 under a magnetic field of 1.5T for each films with deposition temperatures of 700°C, 750°C and 800°C, respectively. The correlation between the MR ratios and lattice constants of films is investigated. As the lattice constants of films were decreased, the MR ratios of films were monotonically increased. It is concluded that the compressive stress on films cause the enhancement of MR ratios of thin films grown on Si (100) substrates.

4T-29. MAGNETORESISTANCE OF $La_{1-x}Sr_xMnO_3$ (x=0.19, 0.24, 0.27) FILMS BY RF MAGNETRON SPUTTER. Young Suk Cho, Jin Seok Hwang-Bo, Yeon Hee Kim, Sang Won Lee, Seung-Iel Park, Chul Sung Kim (Kookmin University, Department of Physics, Seoul, 136-702, South Korea)

La-Sr-Mn-O thin-films have been grown on SiO_2/Si(100) and MgO(100) substrate under rf power of 2.46 W/cm^2 at 700 °C by co-sputtered of

$La_{0.67}Sr_{0.33}MnO_3$ and Sr target. Polycrystalline compound sputtering target $La_{0.67}Sr_{0.33}MnO_3$ has been prepared by a conventional ceramic method. Thickness of deposited La-Sr-Mn-O films were about 1000 Å. Deposited thin-films were annealed for one hour at 800 °C in 1 atmospheric pressure O_2. Properties of the La-Sr-Mn-O films have been studied with XRD, RBS, AFM, and SEM. Chemical composition of deposited La-Sr-Mn-O films was determined by RBS analysis. Postannealed La-Sr-Mn-O films had perovskite orthorhombic structure. For the case of $La_{0.81}Sr_{0.19}MnO_3$ film, the lattice parameters were $a_0 = 5.487Å, b_0 = 5.471Å, c_0 = 7.70269Å$ and V = 231.17 $Å^3$. For increasing Sr ratio, the lattice volume of La-Sr-Mn-O films were increased. The temperature dependent resistance showed that semiconductor-metal transition occurred at 270 K for $La_{0.81}Sr_{0.19}MnO_3$ film on MgO(100). The relative maximum MR is about 46.4 % at 250 K for 15 kOe applied fields. For the Sr ratio increasing, the semiconductor-metal transition temperature was increased, and resistivity and relative MR were decreased.

4T-30. DOPING MANGANITES BY La-SITE VACANCIES AND Ca IONS: INTERPLAY BETWEEN STRUCTURAL, MAGNETIC AND TRANSPORT PROPERTIES. J. P. Araujo, V. S. Amaral, J. B. Sousa (IFIMUP, Dep. Fisica, Rua do Campo Alegre, 687, PORTO, 4050, Portugal) and V. S. Amaral, A. A. C. S. Lourenco (University of Aveiro, Dep. de Fisica, Campus de Santiago, Aveiro, 3810, Portugal) and P. B. Tavares, F. Lencart e Silva (Universidade de Tras-os-Montes, Dep. Ceramica e Vidro, Vila Real, Vila Real, 3810, Portugal) and P. B. Tavares, J. M. Vieira (Universidade de Aveiro, Dep. Ceramica e Vidro, Campus de Santiago, Aveiro, 5000, Portugal)

It is known that ferromagnetism can be induced in $LaMnO_3$ manganites by doping with divalent ions or La-site vacancies. Incorporation of 10% La vacancies would, from valence considerations, lead to a similar behaviour as the optimum substitution by 30% divalent cations, with T_c above 250K. However, few studies on bulk and thin film samples do not confirm this assumption. To get a deeper insight on the roles of these two doping procedures we studied the $La_xCa_yMnO_3$ bulk system. Sets of samples were prepared by solid state route, sintered and annealed in air at $1100°C$. Ac magnetic and transport measurements show that initial incorporation of Ca (y<15%) in a La deficient sample(x>15%) leads to a reduction of T_c, whereas in general the incorporation of vacancies in a Ca doped sample leads to a further increase of T_c. The competing doping effects lead to a saddle point in the 3dimensional plot of T_c vs Ca and vacancy concentrations (at 20% vacancy and 10% Ca). The effects of oxygen annealing are also presented. Thermopower measurements are used to characterize the charge carriers and effective doping of the samples. These results illustrate lattice effects induced by different La site occupations and the consequences on magnetic and transport properties.

4T-31. MAGNETOTRANSPORT PROPERTIES OF THE PEROVSKITE $Nd_{0.67}Sr_{0.33}Mn_{1-x}Co_xO_3$ SINGLE CRYSTALS. Tara P. Dhakal, Kiyotaka Miyoshi, Kenji Fujiwara, Jun Takeuchi (Shimane University, Department of Material Science, 1060 Nishikawatsu, Matsue, Shimane, 690-8504, Japan)

The effect of Co doping on the Mn site in the ferromagnetic phases of the perovskite $Nd_{0.67}Sr_{0.33}Mn_{1-x}Co_xO_3$ has been studied in order to determine the relative importance of the double-exchange interaction. The measured single crystals were grown by the floating zone method. Conduction and ferromagnetism are suppressed by Co doping. The resistivity for x=0.1 material has a large peak near T_c, where a metal-insulator transition seems to take place. Besides, the magnetic field of 7T causes the colossal magnetoresistance of 96% there, which is a little larger than 94% for mother x=0 material. The material with x=0.2 shows a spin glass-like or cluster glass-like behavior instead of a long range ferromagnetic order for x=0 and 0.1 materials. Further doped material with x=0.3 shows the typical spin glass and insulating behaviors with rather small magnetoresistance. Glass-like behavior has been well confirmed by the zero-field-cooled and field-cooled DC magnetization and also linear and nonlinear AC susceptibility measurements. These results are ascribed to the frustration of random competing double-exchange ferromagnetic and super-exchange antiferromagnetic interactions with the introduction of Co^{3+}/Co^{4+} ions. The spin state transition of Co^{3+} ions from high-spin to low-spin as lowering temperatures is found to have an important role for preventing the long range ferromagnetic order and decreasing the pathways for carrier hopping.

4T-32. COLOSSAL MAGNETORESISTIVITY IN $La_{1-X}Sr_xMnO_3$(X=0.1;0.2;0.3)SINGLE CRYSTALS AND THIN FILMS IRRADIATED BY ELECTRONS,PROTONS AND HEAVY IONS. Valentin Arkhipov, Veronika Dyakina, Vasily Gaviko, Alexander Korolyov, Vyacheslav Marchenkov, Edgard Neifeld (Institute of Metal Physics, Low Temperature Laboratory, Kovalevskaya Str., 18, Ekaterinburg, 620219, Russian Federation) and Andrey Arsenov, Alexander Shmatok, Yakov Mukovskii (Moscow State Steel and Alloys Institute, Sythesis Laboratory, Lenin Ave., 4, Moscow, 117936, Russian Federation)

Samples of $La_{1-X}Sr_xMnO_3$ (x=0.1; 0.2; 0.3) single crystals, grown by non-crucible melting with radiation heating, and thin films, produced by magnetron sputtering, were irradiated by electrons (E=5MeV), protons (E=20 MeV) and heavy ions (Kr, E=300 MeV) at T = 60 C. The electroresistivity and magnetization were measured before and after irradiation in the temperature range from 4.2 K to 300 K in magnetic fields up to 8 T. It was shown that simple defects (vacancy and interstitial complexes) generation does not lead a substantial change of the crystallographic structure under electron irradiation. It decreases the colossal magnetoresistivity effect (about 30%) but does not change the type of its temperature dependence. The irradiation of these samples by Kr ions causes the cascades of atomic displacements and leads to the changes of the crystallographic structure and measured electrical and magnetic properties. The possible physical reasons of these are discussed.

4T-33. EFFECT OF FE DOPING IN POLYCRYSTALLINE $La_{0,7}Sr_{0,3}MnO_3$ ON TRANSPORT AND MAGNETIC PROPERTIES. Milton M. Xavier Jr., Francisco A. O. Cabral, Carlos Chesman, José H. Araújo, Thomas Dumelow (Universidade Federal do Rio Grande do Norte, Dpto.de Física Teór. e Experimental, Lagoa Nova, Natal, RN, 59072-970, Brazil)

Ceramics of the doped lanthanum manganates have been the subject of intense research in the recent years[1-2]. These materials are of great importance because of their technological applications in magnetic recordings and sensors. The effect of Fe concentration ($X \leq 0.2$) on two series of ceramic samples of $La_{0,7}Sr_{0,3}Mn_{1-X}Fe_XO_3$, was studied via resistivity, magnetoresistance and AC susceptibility measurements. Each series was subjected to a different thermal treatment, leading to a different particle size for each series. The lattice structure was found to be the same for all samples, but Fe doping was found to decrease the Curie temperature T_C and increase the resistivity of the samples in both series. The relationship between the metal-insulating transition temperature T_{max} and T_C depends on the particle size[3]. A large discrepancy between T_{max} and T_C was found in the series of smaller particle size, whereas in the series with larger particle size T_{max} and T_C appear to coincide. Magnetoresistance does not appear to depend on Fe doping at low temperature ($T = 5K$), at which it displays large values in all the samples in a $0.5T$ field. This has been attributed to spin polarized tunneling at the grain boundaries of polycrystalline manganite samples[4]. A small positive magnetoresistance at low field at about $300K$ was found in the samples with more than 5% Fe doping. This behavior appears to be associated with the Hall effect which dominates the magnetoresistance in this temperature and field range.

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