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ABSTRACTS
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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 30 K. The GMR profiles were analyzed by using the double domain scaling 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.


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 La1-xSrxMnO3-δ (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 La1-xSrxMnO3 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 La1-xCaxMnO3 the O′ phase 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 Tc 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 Ba2FeMoO6. 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 Ba2FeMoO6, which has been prepared by solid-state reaction in a stream of 5% H2/Ar. The temperature dependence of resistivity shows metallic behavior below the ferromagnetic transition temperature of 312 K. 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 Nd1+xSr2−xMnO3. Masayuki Tsukamoto, Kiyotaka Myoshi, Kenji Fujivara, Jun Takeuchi (Shimane University, Department of Material Science, 1060 Nishikawatsu, Matsue, Shimane, 690-8594, Japan)

Magnetic and transport properties of Layered Perovskite Nd1+xSr2−xMnO3 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 Tc1=340 K and Tc2=100 K. The magnetization starts to increase gradually below Tc1, probably due to a two dimensional ferromagnetic alignment. The magnetization decreases having a maximum around Tc2 and under an applied magnetic field of 0.1T and that increases having a shoulder around Tc2 under 0.1T, both of which have a large deference between under zero-field-cooled and field-cooled conditions. Glassy-behavior below Tc2 has been well confirmed by the linear and nonlinear AC susceptibility measurements. The resistivity increases steeply below Tc2 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 La0.75Ca0.25MnO3 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 Seodaemun-gu, Seoul, 120-749, South Korea) and Sam Jin Kim, Chul Sang Kim (Kookmin University, Department of Physics, 861-1 Chungnong-dong Sunbuk-ku, Seoul, 136-702, South Korea)

The enhancement of magnetoresistance (MR) in La0.75Ca0.25MnO3 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 spectoscopy (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 (Δρ/ρ0) 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 La1-xSrxMnO3 (x=0.19, 0.24, 0.27) FILMS BY RF MAGNETRON SPATTER. Young Sük 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 SiO2/Si(100) and MgO(100) substrate under rf power of 2.46 W/cm2 at 700 °C by co-sputtered of
4T-30. DOPING MANGANITES BY LA-SITE VACANCIES AND Ca IONS: INTERPLAY BETWEEN STRUCTURAL, MAGNETIC AND TRANSPORT PROPERTIES. J. P. Araújo, V. S. Amaral, J. B. Sousa (IFIMUP, Dep. Física, Rua do Campo Alegre, 687, PORTO, 4050, Portugal) and V. S. Amaral, A. A. C. S. Lourenço (University of Aveiro, Dep. de Física, Campus de Santiago, Aveiro, 3810, Portugal) and P. B. Tavares, F. Lencastre Silva, V. Real, Vila Real, 3810, Portugal) and P. B. Tavares, J. M. Vieira (Universidade de Aveiro, Dep. Cerâmica e Vidro, Campus de Santiago, Aveiro, 4900, Portugal)

It is known that ferromagnetism can be induced in LaMnO₃ 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 Tₘₓ above 250K. However, few studies on bulk and thin film samples do not confirm this assumption. To get a deeper insight on the role of these two doping procedures we studied the La₂-xCaₓMnO₃ bulk system. Sets of samples were prepared by solid state route, sintered and annealed in air at 1100°C. As magnetic and transport measurements show that initial incorporation of Ca (x<15%) in a La deficient sample (x>15%) leads to a reduction of Tₘₓ, whereas in general the incorporation of vacancies in a Ca doped sample leads to a further increase of Tₘₓ. The competing doping effects lead to a saddle point in the 3-dimensional plot of Tₘₓ 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 Nd₀.₆7Sr₀.₃₃Mn₁₋ₓCOₓO₃ SINGLE CRYSTALS. Tara P. Dhakal, Kyotataki Miyoshi, Kenji Fujiwara, Jun Takeshi (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 Nd₀.₆7Sr₀.₃₃Mn₁₋ₓCOₓO₃ 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 material has a large peak near Tₘₓ, 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 Co³⁺/Co⁴⁺ ions. The spin state transition of Co³⁺ 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 LA₁₋ₓSrₓMnO₃ (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 Marechenkov, Edgard Neifeld (Institute of Nuclear Physics, Low Temperature Laboratory, Kovalevskaya Str. 18, Ekaterinburg, 620219, Russian Federation) and Andrey Arsenov, Alexander Shmatok, Yakov Mukovskii (Moscow State Steel and Alloys Institute, Synthesis Laboratory, Lenin Ave., 4, Moscow, 117936, Russian Federation)

Samples of La₁₋ₓSrₓMnO₃ (x=0.1; 0.2; 0.3) single crystals, grown by non-crucible melt 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 electrorresistivity 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 La₀.₇Sr₀.₃MnO₃ ON TRANSPORT AND MAGNETIC PROPERTIES. Milton M. Xavier Jr., Francisco A. O. Cabral, Carlos Chesman, José H. Araújo, Thomas Damelew (Universidade Federal do Rio Grande do Norte, Dpto.de Física Teó. e Experimental, Lagoa Nova, Natal, RN, 59072-970, Brazil)

Ceramics of the doped lanthanum manganites have been the subject of intense research in the recent years. These materials are of great importance because of their technological applications in magnetic recordings and sensors. The effect of Fe concentration (X ≤ 0.2) on two series of ceramic samples of La₀.₇Sr₀.₃Mn₁₋ₓFeₓO₃, 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 Tₘₓ and AC susceptibility measurements. The relationship between the metal-insulating transition temperature Tₘₐₓ and Tₘₓ depends on the particle size. A large discrepancy between Tₘₐₓ and Tₘₓ was found in the series of smaller particle size, whereas in the series with larger particle size Tₘₐₓ and Tₘₓ appear to coincide. Magnetoresistance does not appear to depend on Fe doping at low temperature (T=5 K), 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. 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.


