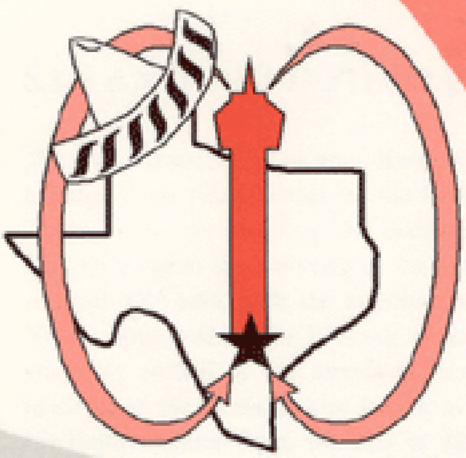
The 8th Joint MMM-Intermag Conference



ABSTRACTS

SAN ANTONIO, TEXAS ▪ JANUARY 7-11, 2001

FW-04. First-order antiferromagnetic and structural transition in Sr-rich $\mathrm{Pr}_{1-x}\mathrm{Sr}_x\mathrm{MnO}_3$.

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Mn^{4+}-rich $Ln_{1-x}A_x\mathrm{MnO}_3$ (Ln = La, Sm, Pr, A = Ca, Sr) compounds exhibit the colossal magnetoresistance (CMR) effect in a narrow range of x and for smaller A-site cation size. They also give complimentary information about the origin of magnetic and electronic properties of $Ln_{1-x}A_x\mathrm{MnO}_3$ to the widely studied region of $x \leq 0.5$, where the CMR effect is the largest. Polycrystalline samples of $\mathrm{Pr}_{1-x}\mathrm{Sr}_x\mathrm{MnO}_3$ ($0.58 \leq x \leq 1.00$) were prepared by a solid-state method. The samples were synthesized in argon flow at 1400-1420°C, followed by low-temperature annealing in air. X-ray diffraction studies show good crystalline quality of the studied samples. Magnetoresistance and magnetization measurements were performed using a Physical Properties Measurement System (Quantum Design) in the magnetic field up to 7 T. For most of the studied samples a sharp drop of the magnetization is observed, due to the antiferromagnetic transition. A kink on the resistivity curves is observed at the same temperature. Both resistivity and magnetization show a clear hysteresis which indicates the first-order nature of the transition. Neutron diffraction data show that the paramagnetic-to-antiferromagnetic transition is accompanied by a cubic-to-tetragonal structural transition. Moderate magneroresistance effect can be observed for lower Sr content, possibly due to ferromagnetic fluctuations. The CMR is not observed for $x \geq 0.70$, where a competition between ferromagnetic and antiferromagnetic order is absent.

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FW-05. The Fe-doping effect on HFMR and LFMR* for polycrystalline La(0.7)Sr(0.3)Mn(1-x)Fe(x)O(3) thin films.

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Extensive studies have been focused on the extrinsic magnetoresistance (EMR) for polycrystalline manganites in order to reduce the field scale. La(0.7)Sr(0.3)Mn(1-x)Fe(x)O(3) (LSMFO) thin films, with x= 0-0.12, have been prepared on [001]-Si substrates using pulsed laser deposition. The Fe-doping effects have been studied by the XRD, AFM, MFM, SIMS, VSM and standard magneto-transport measurements. XRD shows that the films are polycrystalline with a single perovskites structure. Fe-doping causes no apparent structure change. SIMS shows that no Si diffusion from substrate to films. AFM and MFM shows that the films are consist of magnetic single-domain particles with the size of around 70 nm. For the LSMFO films, the metal-insulator transition, T(p), is much lower than the Curie temperature T(c). The discrepancy between T(p) and T(c) is attributed to the grain size effect and oxygen deficiencies. The high field magnetoresistance, HFMR{=d[rho(H)/rho(Hc)]/dH}, is nearly temperature-independent below T(c), whereas the low field magnetoresistance at zero field, LFMR* decreases rapidly with increasing temperature. Moreover, Fe-doping causes a systematically modulation on HFMR and LFMR*. The HFMR is gradually enhanced from 0.0048 /kOe for x= 0 to 0.013/kOe for x=0.08. The LFMR* at 77 K is lowered from 19% for x=0 to 6.6% for x= 0.08. We proposed that for the Fe-doped films, both the lowered spin polarization of conduction electrons and the increased spin flip scattering are responsible for the decrease of LFMR*, while the reduced spin interaction at the grain boundaries is responsible for the enhanced HFMR.

FW-06. Withdrawn.

FW-07. Ru substitution for Mn in CaMnO3: magnetoresistance in new metallic ferromagnetic manganites.

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Pentavalent ruthenium cations have been substituted for Mn in the insulating G-type antiferromagnet $CaMnO_3$. An insulator to metal transition is induced as x increases in $CaMn_{1-x}Ru_xO_3$ and concomitantly a ferromagnetic (FM) component develops with T_C values as high as 210 K. These ferromagnetic metallic (FMM) oxides exhibit better magnetoresistance (MR) properties in low magnetic field (<1T) than the electron rich manganites which are doped by the aliovalent substitution on the A-site of the perovskite. The ruthenium ability to generate FMM compounds is explained by both valency and magnetic effects. B-site doping with a pentavalent cation creates Mn^{3+} charge carriers in the Mn^{4+} matrix which are responsible for the ferromagnetic coupling and the resistivity decrease. However, this valency effect alone is not sufficient, since the substitution of a d^0 pentavalent cation like Nb^{5+} does not induce metallicity. In fact, the low spin $4d^3$ electronic configuration of Ru^{5+} is favorable to the ferromagnetic coupling between the half-filled e_g orbitals of the $3d^4$ Mn^{3+} cations and empty e_g orbitals of Ru^{5+}. Accordingly, as the ruthenium content increases, FM is induced by the Mn^{3+} creation near Ru and furthermore charge delocalization is favored in these clusters by hopping from the half-filled to the empty e_g orbitals. The Ru effect is thus unique among the metallic cations exhibiting higher oxidation states than those of the Mn species.

FW-08. Magnetic phase diagram of the charge ordered manganite $\mathrm{Pr}_{0.8}\mathrm{Na}_{0.2}\mathrm{MnO}_3$.

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The mixed-valence manganites $\mathrm{La}_{1-x}\mathrm{A}_x\mathrm{MnO}_3$ and $\mathrm{Pr}_{1-x}\mathrm{Na}_x\mathrm{MnO}_3$ with alkaline cations $\mathrm{A}=\mathrm{Na}^+, \mathrm{K}^+$ have been synthetized up to $x=0.15-0.20$ and their structural, electric, thermal and magnetic properties have been investigated. Similarly to manganites with divalent alkali earth substituents (e.g. Ca), the increasing concentration of monovalent cations changes gradually magnetic ordering from the layered type antiferromagnetism for $x \sim 0$ through canted arrangements to pure ferromagnetism for $0.10 \leq x \leq 0.15$. The Curie temperatures amount to $T_C = 125-140$ K for Pr based compounds of the orthorhombic $Pbnm$ symmetry while they reach considerably higher values $T_C = 275-320$ K for La based compounds of the rhombohedral $R\bar{3}c$ symmetry. Together with this spin rearrangement, itinerant charge carriers are gradually generated as revealed by electrical resistivity and thermoelectric power data. In dependence on composition and temperature the ceramics show both the CMR and GMR properties. A novelty is the observation of charge and orbital ordering ($T_{co} = 215$ K) of the $\mathrm{Mn}^{3+}/\mathrm{Mn}^{4+}$ (1:1) kind in the $\mathrm{Pr}_{0.8}\mathrm{Na}_{0.2}\mathrm{MnO}_3$ sample (actual Mn^{4+} concentration of 36 percent), followed by an antiferromagnetic "pseudo" CE type arrangement ($T_N = 175$ K). A second magnetic transition is observed at ~ 50 K where the spins in the "pseudo" CE arrangement, directed originally along the [001] crystallographic axis, are reoriented to a perpendicular direction. This transition is associated with spin frustration and/or formation of ferromagnetic clusters and is likely linked to an ordering of excessive e_g electrons in the Mn^{4+} sites. By application of a relatively low field of ≈ 2 T the charge order is dissolved and the compound is converted to the ferromagnetic state. The detailed magnetic phase diagram of $\mathrm{Pr}_{0.8}\mathrm{Na}_{0.2}\mathrm{MnO}_3$ consists of two domains−the charge ordered antiferromagnetic insulator and the ferromagnetic metal. These are separated by a hysteretic region which is reproduced without any relaxation (at least in the time scale of hours) both in the temperature and magnetic loops. The outlined magnetic behaviour together with observed transport properties reflect near degeneracy of the ferro− and antiferromagnetic ground states in $\mathrm{Pr}_{0.8}\mathrm{Na}_{0.2}\mathrm{MnO}_3$.

FW-09. Influence of La defect on the magnetoresistance and magnetic properties of $\mathrm{La}_{1-x}\mathrm{MnO}_3$.

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Influence of lanthanum deficiency on the structural, magnetoresistance, and magnetic properties have studied on a series of $\mathrm{La}_{1-x}\mathrm{MnO}_3$ (x=0, 0.05, 0.1, 0.2, and 0.33) powder samples. The powder samples were prepared by a sol-gel method. The X-ray diffraction analyses of the samples revealed a single phase of rhombohedral symmetry. Magnetization curves showed an antiferromagnetic ordering for x=0.0 with its Neel temperature T_N =138 K, but for the others samples showed ferromagnetic phase. The Curie temperature (T_C) is found to increase from 272 K for x=0.05 to 279 K for the x=0.33 composition. The saturation magnetic moments per Mn atom at 80 K for x=0.0 and 0.10 are 2.30, 3.21 μ_B, respectively. A small increasing La defects resulted in changes of their magnetic structures thoroughly. All the La defect samples, the temperature dependence of resistance shows that metal to insulator transition occurs near the T_C and is closely related to the magnetization. The magnetoresistance value of 30 % ($\Delta\rho/\rho(0)$) has been obtained at 272 K under 2 T for x=0.1 sample. The evidence for the formation of double exchange is also shown in X-ray measurements.

FW-10. Magnetotransport properties of La-Er-Sr-Mn-O polycrystalline samples. *Enrique P. Rivas*, S. Gama, and Adelino A. Coelho (Universidade Estadual de Campinas - IFGW, DFA - GPCM, Caixa Postal 6165, Campinas, SP, 13083-970, BR)

In this work we study the behavior of the magnetic and transport properties of the compounds $La_{0.67-x}Er_xSr_{0.33}MnO_3$(x = 0.07 - 0.19) maintaining Mn^{3+}/Mn^{4+} ratio constant. Changes in the Erbium content of these compounds influence the observed magnetic and metal-semiconductor transitons. This influence may be related to changes in the average radius of the A-cations, less r_A greater, and may be explained by the influence of spin-dependent mechanisms in the transport properties. The observed behavior is consistent with the general conclusion that the magnetic properties are more sensitive to the microstructural details than are the transport properties. Our data on the magnetic transitions suggest that these doped manganites are magnetically inhomogeneous probably with two magnetic phases with close Curie temperatures. On increasing the Erbium content of the compounds from 0.10 up to 0.19, a small displacement of the magnetic transition temperatures from 320 down to 290 K is observed, as well as an enlargement of their temperature interval. Possible origins of these effects of Er doping on the magnetic properties are discussed.

FW-11. The effect of Li - doping on the charge ordering state of $La_{0.5}Ca_{0.5}MnO_3$. S.L. Ye, W.H. Song, J.M. Dai, K.Y. Wang, S.G. Wang, *Y.P. Sun* (Inst. of Solid State Phys., Academia Sinica, LIFD, Kexue Rd. 10, Heifei, Anhui, 230031, CN), and Y.P Sun (Univ. of Science and Technol. of China, Structure Res. Lab., Jinzhai Rd. 96, Heifei, Anhui, 230026, CN)

The effect of Li-doping on charge ordering (CO) state in perovskite-type manganates $La_{0.5}Ca_{0.5-x}Li_xMnO_3$ with x = 0, 0.05, 0.1, 0.15, 0.2 is investigated by transport and magnetic property measurements. The resistivity of the samples decreases with the increase of the Li-doping lever. As x≥0.1, the insulator-metal (IM) transition has been induced and the temperature of IM transition shifts to high temperature with the increasing of Li-doping. Accompanying the variation of transport properties, the sample undergoes the variation from antiferromagnetic (AF) order for x ≤0.05 to ferromagnetic (FM) order for x≥0.1. The experimental results indicate that the Li-doping can destroy the CO state and induce the FM metallic (FMM) state. These phenomena can be interpreted in terms of the strong competition between the CO state and FM phase induced by the Li^+ ions substitution for the Ca^{2+} ions. We suggest that both the magnetic inhomogeneity induced by the different valance between the Ca^{2+} ion and Li^{1+} ion and the increasing of the concentration of the carriers induced by the Li-doping are responsible for the collapsing of the CO and the formation of the FMM state. PACS numbers: 71.30.+h, 74.62.Dh, 75.40.-s, 71.55.Jv

FW-12. Magnetic resonance investigations on La0.65Pb0.35MnO3. *Mircea Chipara*, Sy-Hwang Liou, Qin Xu, Lan, and Richard Shoemaker (Univ. of Nebraska, Phys. and Astron., Behlen Lab. of Phys., Lincoln, Nebraska, 68588-0111, US)

Electron spin resonance (above T_C) and ferromagnetic resonance investigations (below T_C) on $La_{0.65}Pb_{0.35}MnO_3$ powders of different sizes, ranging from 0.1 to 5 microns, are reported. The aim of this contribution is to investigate the size effect, to search for the presence of magnetic interactions above the Curie temperature, and to test the presence of bipolarons in powders of $La_{0.65}Pb_{0.35}MnO_3$. Additional data were obtained on grains of $La_{0.65}Pb_{0.35}MnO_3$ dispersed in polystyrene. The dependence of the resonance line parameters (resonance line position, resonance line width, line asymmetry, and double integral of the resonance line), on temperature and grain size, is investigated. Below T_C, the resonance line is a broad, slightly asymmetric, single line. Above T_C, the resonance line is a symmetric single line, with no hyperfine structure. In the paramagnetic phase, no resonance line located at half field (g = 4) was observed, although the spectrum was very intense. The resonance line position has a strong dependence on temperature in the ferromagnetic region. As it is observed from Figure 1, this behavior is observed even in the paramagnetic phase, up to about 40 degrees above T_C. This shift of the resonance line position towards the g=2.00 value (H=340 mT), as the sample is heated above T_C indicates the presence of magnetic interactions above the Curie temperature. Above 420 K, the temperature dependence of the resonance line position is weaker. The rapid shift of the resonance line position is due to the shape anisotropy and reflects decay of the magnetization at saturation, as the temperature of the sample is increased. The resonance line width is increased as the temperature of the sample is increased (Figure 2), obeying an Arrhenius like dependence. The result is consistent with the presence of polarons, close to the Curie temperature.

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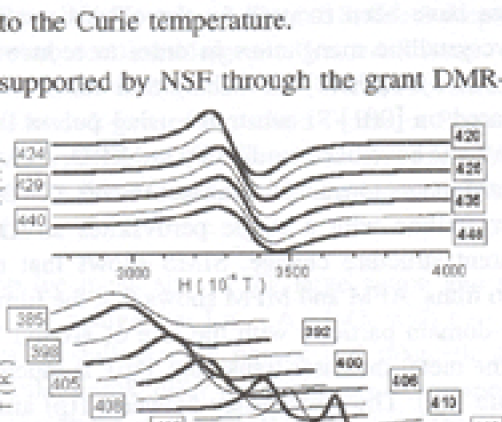

FIG. 1. The resonance line of a powder of 0.5 microns, at different temperatures.

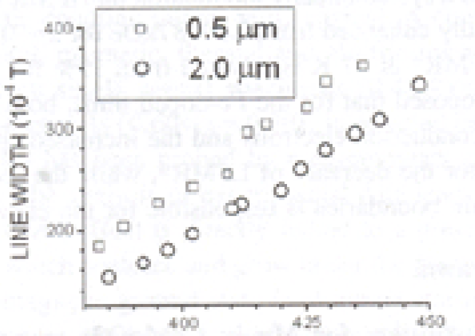

FIG. 2. The temperature dependence of the resonance linewidth for a powder of 0.5 microns