ABSTRACTS

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prepared through sol-gel precursors and measurements of x-ray powder diffraction showed that all samples were single phase. Characterizations of these samples through electrical resistance R(T) and magnetization M(T) measurements showed the occurrence of a ferromagnetic transition at temperatures close to $T_C \sim 260$ and 170 K in Fe-free samples with x = 0 and 0.1, respectively. The partial substitution of Mn by Fe (1 at. %) in samples with x = 0 has minor effect on decreasing T_C to about 240 K. On the other hand, a drastic decrease in Tc was observed in samples with x = 0.1, where $T_C \sim 100$ K. Such an appreciable decrease in T_C is not likely to be related to magnetic interactions between Fe ions in the matrix, given the highly diluted state of Fe ions inferred from the linewidth values of Mössbauer data taken at several temperatures. Mössbauer spectra at room temperature of samples with x = 0 and 0.1 were fitted using two doublets. The most populated site, S1, amounting ~ 97 % of the total spectral area in the x = 0.0 sample, has a small quadrupolar splitting (ΔQ = 0.17(1) mm/s) indicating small distortions of the Fe sites. The second site, S2, amounts about 3 % of the spectral area and has a much larger ΔQ = 1.37(1) mm/s value. Narrow lines ($\Gamma \sim 0.3$ mm/s) were observed in both S1 and S2 signals, indicating good homogeneity of the samples. For samples with x = 0.1, the resonant spectral area of the S1 doublet decreased to 89(1) %, whereas the S2 increased to 11(1) %. Both sites displayed larger linewidth ($\Gamma \sim 0.4$ - 0.6) values probably due to the effect of Y substitution on the local Fe environments. On the other hand, the isomer shift of the S1 doublet was found to be the same (IS = 0.37(1) mm/s) within experimental error in both x = 0.0 and 0.1 samples. Below T_C, two magnetically ordered Fe sites were observed in both x = 0.0 and 0.1 samples. For the former, the hyperfine fields B1 = 52.0(1) T and B2 = 47.9(1) T were in agreement with previously reported results and showed relative populations of 74 % and 26 %, respectively. The observed temperature dependence of the spectral areas indicates that both signals correspond to the same Fe site of the crystal lattice but at different phases. Values of magnetoresistance close to T_C were found to be larger in samples with x = 0.1 and associated with the relative proportion of these two different phases.

ES-05. Neutron diffraction and Mössbauer studies on $Fe_{1-x}Cr_2S_4$(x=0.0, 0.04, 0.08). *S.J. Kim*, W.C. Kim and C.S. Kim. *Department of Physics, Kookmin University 861-1, Chong Rung Dong, Sung Buk Gu, Seoul 136-702, South Korea*

Polycrystalline samples of $Fe_{1-x}Cr_2S_4$(x=0.0, 0.04, 0.08) have been studied with X-ray and neutron diffraction, Mössbauer spectroscopy, magnetization, and magnetoresitance (MR) measurements. The crystallographic and magnetic structures of $Fe_{1-x}Cr_2S_4$(x=0.0, 0.04, 0.08) have been examined in order to explain the CMR mechanism of sulphur spinels. The purpose of these reports is to study the effects of a small Fe-deficiency and conduction mechanism on $FeCr_2S_4$. Neutron diffraction patterns were obtained at various temperature ranges from 10 K to room temperature. Crystallographic and magnetic structure were found to be a normal cubic spinel of Fd3m and ferrimagnetic ordering, respectively. Neutron diffraction on $FeCr_2S_4$ above 10 K shows that there is no crystallographic distortion and reveals antiferromagnetic ordering, with the magnetic moment of Fe^{2+}(-3.12 μ_B) aligned antiparallel to those of Cr^{3+}(2.87 μ_B). Mössbauer spectra were recorded from 4.2 K to room temperature. On the temperature range from13 to 170 K, the asymmetric line broadening is observed and considered to be dynamic Jahn-Teller stabilization. Isomer shift value at 170 K for the sample x=0.04 was 0.6 mm/s, which means that charge state of Fe ions is ferrous in character. With increasing Fe deficiency, the peak of maximum MR of x=0.0, 0.04, and 0.08 were occurred at 171, 174, and 186 K, respectively. The increasing of MR peaks position is interpreted with an enhancement of activation energy.

ES-06. Room temperature magnetic field induced structural transformation in $Pr_{0.65}Ca_{0.35}MnO_3$ *I. Bergenti*[1,2], V. Dediu[1] and G. Ruani[1]. *1. Istituto di Spettroscopia Molecolare, CNR, via Gobetti 101 40129, Bologna, Italy; 2. Phys. Dept., University of Parma and INFM, Parco Area delle Scienze 7/a 43100, Parma, Italy*

Praseodymium manganites $Pr_{1-x}Ca_xMnO_3$ are characterized by unusual magnetic, electrical and optical properties. The optimally doped Pr manganites (x=0.3-0.5) are insulating down to low temperatures and exhibit below ~230 K a charge ordering effect (CO). Differently from "typical" manganites they are never ferromagnetic, showing a paramagnetic-antiferromagnetic transition below 180 K. It was shown [1] that at low temperatures the metallic ferromagnetic phase can be induced by applying an external magnetic field as well as x-ray and visible light radiation, strong electric field and high pressure. The $Pr_{1-x}Ca_xMnO_3$ is a Jahn-Teller (JT) system characterized at room temperature by two strong Raman peaks at 475 cm^{-1} and 610 cm^{-1}, typical for all orthorhombic modifications of manganites.In this work, we present the Raman scattering investigation of $Pr_{0.65}Ca_{0.35}MnO_3$ polycrystalline samples and epitaxial films at room temperature. The films were grown on (110) oriented $NdGaO_3$ substrates by Channel-Spark ablation [2]. The Raman spectra for both polycrystals and epitaxial films consist of two orthorhombic peaks (475 cm^{-1} and 610 cm^{-1}), while an additional peak at 450 cm^{-1} is also observed. This peak is strongly enhanced upon applying a magnetic field. The dynamics of this effect is different for the bulk and thin film samples: switching of the magnetic field the peak intensity goes down and relaxes to previous values for bulk samples, while for the epitaxial films the intensity remains constant even after annealing at high temperatures (950 K).To explain this results a structural transformation under the effect of magnetic field is supposed, similar to the ones observed previously at low temperatures. In thin films, this transformation leads presumably to a higher film-substrate matching, providing thus a very stable structural configuration

[1] H. Yoshizawa, H. Kawano, Y. Tomioka, Y. Tokura, Phys. Rev. B, **52** R13145 (1995)
[2] V. Dediu et al. Supercond. Sci. Technol., **8** 160 (1995)

ES-07. Spin polarized scanning tunneling microscopy study of epitaxial $La_{0.7}Sr_{0.3}MnO_3$ films. *V. Dediu*, F. Biscarini, M. Cavallini and P. Nozar. *Istituto di Spettroscopia Molecolare (ISM), CNR, Via P. Gobetti, 101, 40129, Bologna, Italy*

The magnetic homogeneity of epitaxial $La_{0.7}Sr_{0.3}MnO_3$ films was studied by spin polarized Scanning Tunneling Microscopy technique (SP-STM). Electrochemically etched Ni wires were used as SP tips.$La_{0.7}Sr_{0.3}MnO_3$ films deposition was performed by Channel-Spark ablation on $NdGaO_3$ substrates in oxygen atmosphere. Two different sets of films were investigated: as deposited films (T_{dep} = 1050 K, P_O2 = 0.02 mBar), and high vacuum annealed films (T_{an} = 800 K, $P_{O2} < 10^{-3}$mBar) with high oxygen homogeneity [1].In our experiment, STM was operated at room temperature. For each bias voltage, we acquired both topography z(x,y) and tunnelling spectroscopy map (STS) dI(x,y)/dV by applying a modulation on the bias voltage while holding the feedback.All the films consist of high conductivity ferromagnetic regions (FM) and low conductivity defects identified as paramagnetic inclusions (PM). It was found that the paramagnetic defects cover less than 0.1% of the film surface for samples annealed in vacuum, while as deposited films consist roughly of 50/50% mixture of high conductivity and low conductivity regions (similarly to the La-Ca-Mn-O samples studied earlier [2]). The variation of the material conductance is correlated to the metallic ferromagnetic and insulating paramagnetic phase segregation. The STS contrast between regions with different conductivity amounts to more than one order of magnitude in conductance.The d(lnI)/d(lnV) curves as function of bias voltage show a strong difference for FM and PM regions. The curves measured on paramagnetic regions are smooth corresponding to an ohmic like behavior . The ferromagnetic region curves, on the other hand, exhibit a non-linear gap-like behavior: the signal roughly duplicates above ~1.3-1.5 V, while the transition region is ~1 eV wide. No difference was observed between annealed and as deposited films, apart for the fractional coverage. As a comparison, the characteristics obtained by Pt-Ir tips on the same films show a featureless ohmic-like behavior for both regions. The results can be explained by assuming the switching from the spin-up channel only to both spin channels conductivity (spin-up + spin-down) in the spin polarized Ni /tunnel gap/$La_{0.7}Sr_{0.3}MnO_3$ circuit.

1. Dediu V. et al., Phys. Stat. Sol. (b), v. 215, 625(1999)
2. Fäth M. et al., Science, v. 285, 1540(1999)

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