

PR10.05.26 THE SUPERCONDUCTING STRUCTURE FRAGMENTS WITH T_C 180K. G.M. Kuz'micheva, S.I. Mukhina, Academy of Fine, Chemical Technology, Moscow, Russia; A.V. Mitin, Institute for Physical Problems, RAS, Moscow, Russia; E.P. Khlybov, Institute for High Pressure, Physics RAS, Troitzk, Russia

The study of the temperature variation of the electrical resistivity and the current-voltage characteristics of phases in the La-Sr-Ti-O, Ln-Sr-Nb-O, La-Mn-O, Ba-Sr-Pb-O, La-Pb-Re-O, Mg-Ti-O systems suggests that some compositions contain superconducting inclusions. The structure of superconducting inclusions (structure fragments) is coherently connected with structure of the non-superconducting phase and has different composition from one. A similar phenomena was observed in samples of the well-known system $YBa_2Cu_3O_{6+x}$ when increased from 0.2 to 0.5. The phases of compositions $(Ln,Sr)_xNbO_{3-x}$, $(La,Sr)_xTiO_{3-x}$, $(La,Pb)_xReO_{3-x}$, which belong to cubic bronzes of perovskite structure, contain superconducting structure fragments with T_C 160 K, i 50K and i 60K, respectively. The phases $(Ba,Sr)PbO_3$ (perovskite structure) with i 70K and $Mg(Mg,Ti)_2O_4$ (spinel structure) with i 130K have the cubic symmetry. There are indications of the possible presence of superconducting fragments with T_C 180K in the phase $LaMnO_{3+x}$ with rhomboedral perovskite structure. The dependence of the critical temperatures of the phases, T_C , and inclusions, i , on formal charge of Ti, Nb, Pb, Re, Mn, Bi, Cu cations is found.

Materials VI

Giant Magnetoresistive Materials

MS10.06.01 STRUCTURAL "TUNING" OF MAGNETISM IN $A_{1-x}A'_xMnO_3$ ($A = La, Pr$; $A' = Ca, Sr, Ba$). P.G. Radaelli^a, D.E. Cox^b, M. Marezio^{c,d}, S.-W. Cheong^d, P. E. Schiffer^d, A.P. Ramirez^e, D.N. Agryiou^e and J.D. Jorgensen^e, ^aInstitut Max Von Laue-Paul Langevin, BP156, 38042 Grenoble Cedex FRANCE, ^bPhysics Dept., Brookhaven National Lab, Upton, NY, ^cLab de Cristallographie, CNRS/UJF, BP166, 38042 Grenoble Cedex FRANCE, ^dAT&T Bell Labs, Murray Hill, NJ, ^eMaterials Science Div., Argonne National Lab, Argonne, IL 60439

Manganese oxide perovskites with general formula $A_{1-x}A'_xMnO_3$ ($A = La, Pr, Y, \dots$; $A' = Ca, Sr, Ba, \dots$) have been the subject of renewed interest, due to the giant magnetoresistance (GMR) exhibited near the ferromagnetic (FM) spin ordering temperature T_C . In fact, for values of the electronic doping $x \sim 0.30$, the high-temperature paramagnetic state is electrically insulating, whereas the low-temperature FM state is metallic. The Curie temperature can be raised upon application of an external magnetic field, thereby producing the GMR effect. At higher doping levels ($x > 0.50$) the system is antiferromagnetic at low temperatures, and, in a narrow region of composition around $x=0.50$, both types of magnetic order occur. The presence of structural anomalies associated with the magnetic transitions in $A_{1-x}A'_xMnO_3$ ($x=0.25$, $x=0.30$ and $x=0.50$) has been evidenced by high-resolution synchrotron x-ray and neutron powder diffraction. In all cases, the lattice parameter anomalies are associated with a significant rearrangement of the Mn-O bond lengths, so that the MnO_6 octahedra are Jahn-Teller-distorted in the insulating state, and almost undistorted in the metallic state. These results provide strong experimental evidence for the importance of static/dynamic Jahn-Teller distortions as a charge carrier localization mechanism. Very recently, it has been shown that, at a constant value of the electronic doping level x , the Curie temperature can be "tuned" by changing the average radius $\langle r_A \rangle$ of the A-site ion or by applying external pressure (dT_C/dP is always *positive*, although its value changes significantly as a function of $\langle r_A \rangle$). To study this effect, the structural phase diagram of the $A_{0.7}A'_{0.3}MnO_3$ system ($A = La, Pr$; $A' = Ca, Sr, Ba$) was determined by neutron powder diffraction as a function of temperature, pressure and $\langle r_A \rangle$.

In addition to confirming that the overall increase of T_C as a function of $\langle r_A \rangle$ is associated with a reduction of the structural distortion from the cubic symmetry, this study has evidenced the extreme sensitivity of T_C to the average Mn-O distance. In fact, as a function of $\langle r_A \rangle$, $\langle Mn-O \rangle$ has a *minimum* that coincides with the *maximum* of the Curie temperature. Furthermore, the structure responds to external pressure by a compression of the Mn-O bond lengths, while the Mn-O-Mn bond angles are only slightly pressure-dependent.

MS10.06.02 MAGNETOSTRUCTURAL PHASE TRANSITIONS IN $La_{1-x}Sr_xMnO_3$ WITH CONTROLLED CARRIER DENSITY. Atsushi Asamitsu¹ and Yoshinori Tokura^{1,2} ¹Joint Research Center for Atom Technology, Tsukuba 305, Japan ²University of Tokyo, Tokyo 113, Japan

Magnetic field-induced structural phase transitions as well as thermally induced ones between the orthorhombic (O) and rhombohedral (R) structures have been investigated for perovskite-type manganese oxides, $La_{1-x}Sr_xMnO_3$, with finely controlled carrier density ($x=0.160, 0.170$ and 0.180). In $x=0.170$ crystal, the composition of which is tuned so that the structural transition temperature TS ($\approx 285K$) is located close to the ferromagnetic transition temperature T_C ($\approx 264K$). As a result, novel magnetostructural effects have been observed: the TS is lowered by more than 50K with application of an external magnetic field of 7T. We determined the structural phase diagram in the field-temperature plane from measurements of the lattice striction. Utilizing the structural phase diagram, we can switch the crystal structure, reversibly or irreversibly, between the O- and R-phases by applying magnetic field at a fixed temperature. Such a large magnetostructural effect arises from the mutual coupling among the transfer interaction of doped e_g carriers, the local spin moment of t_{2g} electrons, and the lattice distortion. In the case of $La_{1-x}Sr_xMnO_3$ crystal, the transfer interaction of e_g carriers that is responsible for the ferromagnetic double-exchange interaction and hence the induced magnetization M is larger in the R-phase than in the O-phase in a magnetic field. Therefore the gain of the free energy by Zeeman term, $-M \cdot H$, can drive the field-induced structural transition from the O- to R-phase. Thermodynamical aspects of these phenomena are understood semi-quantitatively in terms of the Landau free energy with coupled order parameters, the magnetization M and the lattice distortion Q .

In $x=0.160$ or 0.180 , on the other hand, the T_S 's are not changed conspicuously up to 7T, since their T_S and T_C differ considerably, either $T_S \gg T_C$ or $T_S \ll T_C$, and hence the effective coupling between M and Q is reduced.