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, Ba-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 phenomenon was observed in samples of the well-known system YBa2Cu3O6+, when increased from 0.2 to 0.5. The phases of compositions (La,Sr)O2−x (La,Sr)2O3−x (La,Pb)O3, which belong to cubic braces of perovskite structure, contain superconducting structure fragments with Tc160 K, i=50K and i=60K, respectively. The phases (Ba,Sr)MnO3 (perovskite structure) with i=70K and Mg(Ti)2O3 (spinel structure) with i=130K have the cubic symmetry. There are indications of the possible presence of superconducting fragments with Tc180 K in the phase LaMnO3, with rhomboedral perovskite structure. The dependence of the critical temperatures of the phases, Tc, and inclusions, f4, on charge of Ti, N, Pb, Re, Mn, Bi, Cu cations is found.

Materials VI
Giant Magnetoresistive Materials

Manganese oxide perovskites with general formula A2-xMnO3 (A = La, Pr; A' = Ca, Sr Ba) have been the subject of renewed interest, due to the giant magnetoresistance (GMR) exhibited near the ferromagnetic (FM) spin ordering temperature Tc. In fact, for values of the electronic doping x=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 A1−xA'xMnO3 (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 MnO3 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 <rA> of the A-site ion or by applying external pressure (dTc/dP is always positive, although its value changes significantly as a function of <rA>.) To study this effect, the structural phase diagram of the A0.2A'0.8MnO3 system (A=La, Pr; A'=Ca, Sr Ba) was determined by neutron powder diffraction as a function of temperature, pressure and <rA>.

In addition to confirming that the overall increase of Tc as a function of <rA> is associated with a reduction of the structural distortion from the cubic symmetry, this study has evidenced the extreme sensitivity of Tc to the average Mn-O distance. In fact, as a function of <rA>, <Mn-O> 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.