Materials V
High Tc Superconducting Materials

MS10.05.01 HIGH Tc SUPERCONDUCTORS AND RELATED OXIDES : HIGH PRESSURE PHASES. Mikio Takano, Institute for Chemical Research, Kyoto University.

High Tc, cupric oxide superconductors and related quantum antiferromagnets prepared at high pressures of 6 GPa typically will be reviewed. Nearly all high pressure phases studied so far have been synthesized under severe pressure conditions, and only a few high pressure phases have been stabilized at lower pressures, thus raising the question of the origin of high pressure superconductivity. It is expected that high pressure phases of various cuprate superconductors can be synthesized and studied at near ambient pressure.

Superconductors prepared at high pressure are featured by the multiplicity of the 2D CuO2 sheets (e.g. Sr2NiCuO4:2, Sr2Ba2Cu4O8), inclusion of 2D CuO2 sheets capped with halogen atoms (e.g. Ca3Cu2O3F2 and Sr2CaCu2O3F2), etc. Many other new phases will be prepared in near future.

The speaker's group is now more involved in a research of spin-ladder compounds. SrCu2O2 and La2CuO4 phases prepared at 3.6 GPa contain two-leg ladders, the legs and the rungs of which are CuO chains and Cu-O-Cu bonds, respectively. The electronic ground state of SrCu2O2 has been found to be a singlet spin liquid, which is separated from the first excited magnetic state by a wide “spin gap” of 420 K. On the other hand, interladder interactions cause long range magnetic ordering in the latter oxide, though the ordering is easily destroyed by the substitution of Sr2+ for La3+. Novel physics of quantum spin ladders is progressing fast.

MS10.05.02 UNUSUAL LAYERED METAL OXIDES. Susan M. Kauzlarich, Department of Chemistry, University of California, Davis, California 95616

There are a relatively small number of transition metal pnictide oxides compounds that have been reported to date. Of these types of compounds, the Sr3Mn2As2O7 structure type has the unique feature of independent metal oxide and metal pnictide layers which form a 1:1 intergrowth. The structure and properties of compounds which crystallize in this structure-type will be presented along with new results in this area.

MS10.05.03 LAYERED CUPRATES. Kenneth Poeppelmeier, Department of Chemistry and Science and Technology Center for Superconductivity, Northwestern University, Evanston, Illinois 60208

Layered copper-oxide superconductors exhibit the highest critical transition temperatures of any materials. Yet all the known double perovskites A2B’O6 containing copper have a random or rock salt distribution of the B cations with the exception of the unique layered arrangement found in La2CuSnO4. Only the layered arrangement contains the CuO2+ planes which are necessary for high-temperature superconductivity. The occurrence of layered or two-dimensional structures increases markedly when vacancies are introduced on the oxygen sublattice. Similarities among oxygen-deficient structures, especially those with two-dimensional solid-state features, will be discussed. Combined conductivity and thermopower analysis will be presented to elucidate the unique internal chemistry, defect structure, and conduction parameters associated with the quadrupole perovskites La2Ba2Cu4O8 and LaBaCu2Ti2O7. The similarities of layered Cu-Sn and Cu-Ti perovskites to high Tc cuprates will be presented.


MS10.05.04 Hg-BASED SUPERCONDUCTING Cu MIXED OXIDES. E. V. Antipov1, S. N. Patlin2, E. M. Kopnin3, V. A. Alyoshin, A. M. Balagurov2, S. M. Loureiro3, J. J. Capponi3, M. Marezio4,1Dpt. of Chemistry, Moscow State University, Moscow 119899 Russia; 2Lab. of Neutron Physics, JINR, Dubna, Russia; 3Lab. de Cristallographie CNRS, BP 166, 38042 Grenoble France; 4MASPEC, Parma, Italy.

The arrangement of the (CuO2) layers in the HgBa2Ca2Cu3O10+2 structures is supposed to be optimal for the existence of superconductivity at high temperatures. The structure investigation of these compounds is important for understanding the superconductivity phenomenon among layered Cu mixed oxides.

The six members of the series were isolated and characterized. The third member (Hg-1223) undergoes superconducting transition at the highest Tc, while the other members exhibit lower superconducting transition temperatures due to several reasons such as underdoping of the higher members and alterations of the in-plane and apical Cu-O bond lengths.

The neutron powder refinement was made for monophasic HgBa2Ca2Cu3O8+δ samples prepared in sealed tubes with different extra oxygen content (δ=0.055, 0.12 and 0.18) and Tc (71K, 98K and 83K, respectively). No substitution on the Hg site and additional extra oxygen except the one in the middle of the mesh in the Hg-layer was found. The dependence of Tc vs. δ will be discussed.

The substitutions of Hg and O atoms in the (HgO) layer of the HgBa2Ca2Cu3O8+δ structure by carbonate (sulphate) group and fluorine, respectively, were studied. The different geometry or formal valence of substituents causes different variations of the structure and properties of the Hg-1201 superconductor.

This work was partially supported by ISF (M1G300), the Russian Scientific Council on Superconductivity (Pol’sk), INTAS (N93-2483) and JNICT/PRAXIS XX/BD 3528/94.