Oxygen K NEXAFS Studies High Temperature Superconductors

A.R. Moodenbaugh (BNL), D.A. Fischer (NIST), and C.W. Chu (U. Houston)

Abstract No. mood1572
Beamline(s): **U7A**

Introduction: Oxygen K near-edge soft x-ray absorption fine structures (NEXAFS) were obtained for a series of related polycrystalline $RuSr_2GdCu_2O_8$ (Ru-1212) samples. Superconducting properties ranged from fully superconducting to magnetic and nonsuperconducting. In the high T_c cuprates, the oxygen K NEXAFS of high temperature superconductors is used to measure the degree of hole doping (crucial for the appearance of superconductivity), through the intensity of a pre-edge feature, the "hole peak". The ruthenates, being 4d materials, have characteristically complicated oxygen K NEXAFS, and these Ru-1212 materials also contain important Cu-O bonds. In this work we attempt to identify an oxygen K "hole peak" comparable to that observed in the cuprates and to correlate that feature with superconducting properties. For comparison, we also obtained oxygen K NEXAFS for another, simpler, layer perovskite Sr_2RuO_4.

Methods and Materials: The bulk polycrystalline samples, all with the same nominal compositions, were characterized by x-ray diffraction to be single phase. Properties varied from being fully superconducting, to displaying no superconducting transition (Xue, *et al*.) Fluorescence yield data were obtained for the oxygen K edges. The energy resolution of the incident photons is 0.2 eV. The data were normalized to I_0, the photon yield from a clean gold grid intercepting the incident beam, and the pre-edge intensity was subtracted. To isolate the pre-edge features from the main edge, a Gaussian shape approximating the edge position and shape was subtracted from the data.

Results: The Oxygen K NEXAFS of the pre-peak region (526-534 eV) all show 3 peaks (see **Figure 1**). The character of the NEXAFS of this energy is quite similar to that of previously published data for La_2RuO_4. There are overlapping peaks, which can be well explained using three-Gaussian fits. The intensity of the leading pre-peak near and energy E=528eV is greatest for the best superconducting sample, being 15% greater that that of the magnetic sample of the same nominal composition.

Conclusions: The oxygen K NEXAFS of the Ru-1212 materials has much in common with that of Sr_2RuO_4, in spite of the presence of Cu in the Ru-1212 atoms in identical numbers as Ru. The apparent minor influence of Cu may be due to the relatively fewer number of Cu-O bonds (with a corresponding lower pre-peak intensity). The intensity of a pre-edge feature (near E=528eV) is greater in samples showing superconducting behavior. This is qualitatively similar to the behavior of the whole peak observed in the cuprates. It is not clear whether the variation in pre-peak intensity is due to changes in Cu-O or in Ru-O bonds.

Acknowledgments: S. Sambasavan and Z. Fu helped collect the data.

Reference: Y. Y. Xue, S. Tsui, J. Cmaidalka, R. L. Meng, B. Lorenz and C. W. Chu, "ac and dc Magnetic Susceptibility of RuSr2GdCu2O8", to be published, Physica C.

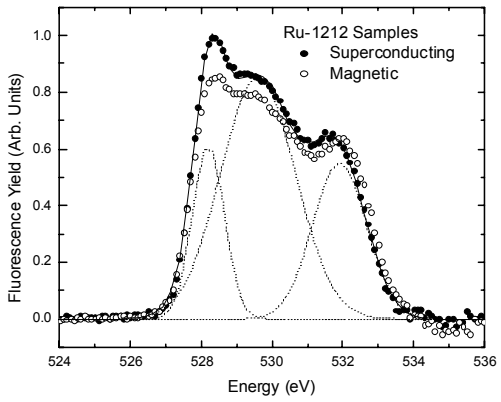

Figure 1. Fluorescence yield for oxygen K NEXAFS pre-edge region after subtraction of bulk edge. For comparison are a superconducting (S) Ru-1212 and a magnetic (M, nonsuperconducting) Ru-1212. Data for both samples can be fit with three Gaussian peaks (shown for S). For S, the leading pre-peak near 528 eV is about 15% more intense than for the M peak.