

The Oxygen K-Edge XANES of $\text{RuSr}_2\text{RCu}_2\text{O}_8$ (R = Rare Earths)

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High temperature superconductivity with anomalous magnetic properties was reported in the weak-ferromagnetic Ru-1212 system $\text{RuSr}_2\text{RCu}_2\text{O}_8$ (R = Pr, Nd, Sm, Eu, Gd). [1] For the prototype compound $\text{RuSr}_2\text{GdCu}_2\text{O}_8$, the occurrence of superconductivity with transition temperature T_c onset as high as 60 K is related to the quasi-two-dimensional CuO_2 bi-layers separated by a rare earth in the Ru-1212 structure. The weak-ferromagnetic order with a Curie temperature $T_{\text{Curie}} \sim 130$ K above T_c is due to ordered Ru moments in the RuO_6 octahedron through a strong $\text{Ru}/4d\text{-O}/2p$ hybridization. Here we report the oxygen K-edge x-ray absorption near edge structure (XANES) spectra of metal-insulator transition in the oxygen-annealed $\text{RuSr}_2\text{RCu}_2\text{O}_8$ system (R = rare earths).

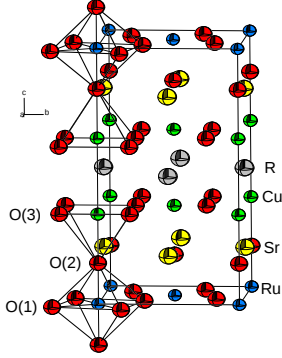


Figure 1. The structure of $\text{RuSr}_2\text{RCu}_2\text{O}_8$ (rare earths).

The resistivity of $\text{RuSr}_2\text{RCu}_2\text{O}_8$ in Fig. 2 shows the metallic behavior for Eu and Gd, and insulator behavior for Pr and Nd. The metal-insulator transition boundary was near R = Sm.

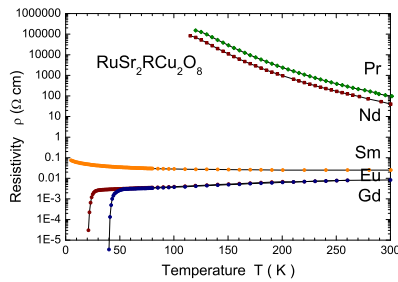


Figure 2. The resistivity of $\text{RuSr}_2\text{RCu}_2\text{O}_8$ (rare earths).

The normalized O K-edge (1s-2p dipole transition) XANES at 30 K, 60 K, and 300 K for $\text{RuSr}_2\text{GdCu}_2\text{O}_8$ were shown in Fig. 3. The pre-edge peak indicates inner 1s electron transfer to 2p hole near oxygen atom. Three peaks at pre-edge of XANES were at 524.7 eV, 528.1 eV, and 528.75 eV, the lowest absorption edge 524.7 eV was identified O(1) in CuO_2 plane. The two peaks at 528.1 eV and 528.75 eV are O(2) and O(3) around RuO_6

octahedron.

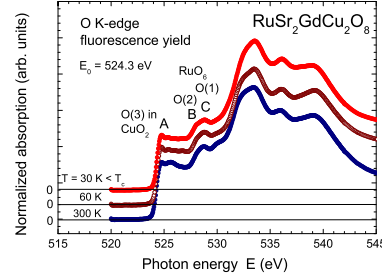


Figure 3. The oxygen K-edge XANES at 30 K, 60 K, and 300 K for $\text{RuSr}_2\text{GdCu}_2\text{O}_8$.

The normalized O K-edge (1s-2p dipole transition) XANES at 300 K for $\text{RuSr}_2\text{RCu}_2\text{O}_8$ (R = rare earths) were shown in Fig. 4. The XANES of $\text{RuSr}_2\text{PrCu}_2\text{O}_8$ is different from others of $\text{RuSr}_2\text{RCu}_2\text{O}_8$. The local environment of $\text{RuSr}_2\text{PrCu}_2\text{O}_8$ was different from other sample. A larger absorption peak of $\text{RuSr}_2\text{SmCu}_2\text{O}_8$ near 524 eV indicates that structure is more distorted than structure of $\text{RuSr}_2\text{GdCu}_2\text{O}_8$.

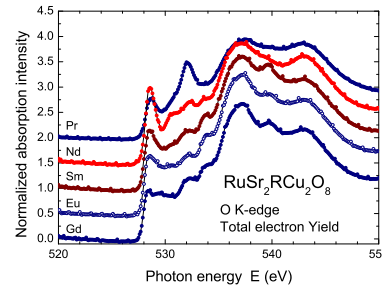


Figure 4. The oxygen K-edge XANES for $\text{RuSr}_2\text{RCu}_2\text{O}_8$ (R = rare earths) at 300 K.

REFERENCES

1. C. Y. Yang, B. C. Chang, H. C. Ku, and Y. Y. Hsu, Phys. Rev. B **72**, 174508 (2005).