

Investigation of the Interface Properties of YBCO/LSMO by Soft X-ray Absorption

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The physics properties of interface between superconductor and ferromagnetic material have attracted a lot of interest because of their unique electronic and magnetic properties. We have used the soft X-ray absorption to investigate the interface electronic structure and magnetic properties between $\text{YBa}_2\text{Cu}_3\text{O}_7$ and $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$, where the $\text{YBa}_2\text{Cu}_3\text{O}_7$ is a superconductor which transition temperature is about 89K and $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$ is ferromagnetic which have high spin polarization.

Figure 1 shows the linear polarization soft X-ray Cu L_3 edge absorption spectra (XAS). The polarization of X-ray is perpendicular to c-axis for Fig. 1(a), parallel to c-axis for Fig. 1(b). The black line represents the spectra of 10nm thickness YBCO capped by 1nm LSMO, the red line capped by 3nm and green line capped by 5nm, respectively. Each spectrum is normalized so that their respective integrated areas are equal.

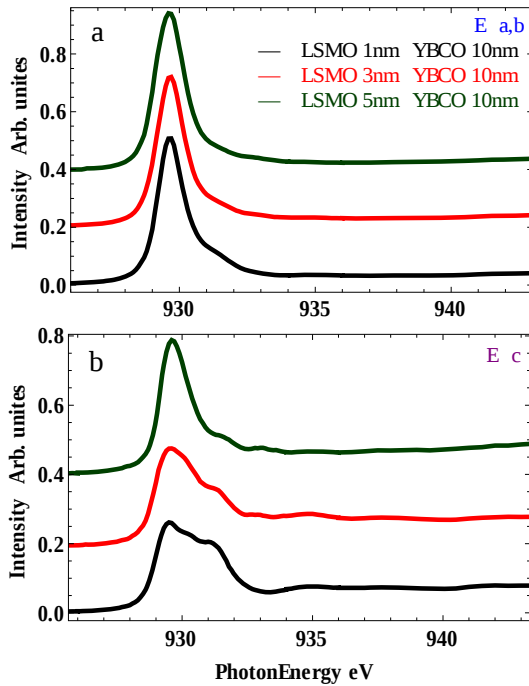


Figure 1: The Cu L_3 edge linear polarization soft X-ray absorption spectra of YBCO/LSMO. (a) The polarization is parallel to c-axis. (b) The polarization is perpendicular to c-axis.

There are two signatures about the Cu absorption spectra. The main peak at about 929.6 eV is due to the transition from the Cu 2p core level into unoccupied Cu 3d state ($2p^63d^9 \rightarrow 2p^53d^{10}$). The shoulder at about 931.2

ev is due to the transition to ligand holes ($2p^63d^9 \rightarrow 2p^53d^{10}\underline{L}$). The ratio of interface signal increases with the thickness of LSMO capped layer increasing. Figure 2 shows the ratio of shoulder and main peak area for different samples.

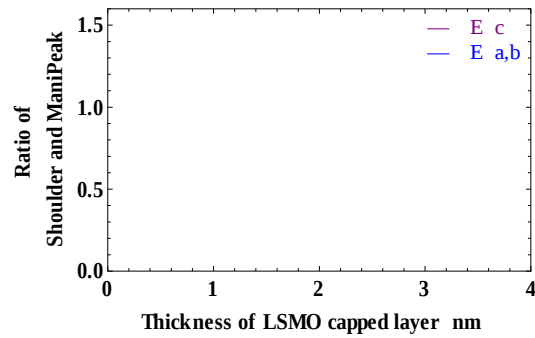


Figure 2: The ratio of Cu L_3 edge absorption spectra shoulder and main peak area for YBCO with different capped LSMO layer

Our data clearly show that the change of spectra for x-ray polarization parallel to c-axis is more pronounced than that for polarization perpendicular to c-axis. This means the change of electronic structure about c-axis is more evidence. The change of main peak spectra weight is due to the orbital reconstruction at interface[1]. We also note that the spectra weight of shoulder for 5nm thickness LSMO capped layer is much less than the other. This shoulder spectra weight is related to the electron holes concentration in the YBCO. This means the concentration of holes at interface is less than in the bulk. We predict that is the result of charged holes transfer from YBCO side to LSMO side.

Reference

[1] J. Chakhalian *et al.*, Science **318**, 1114 (2007).