2C/2005G149, 2005S2-002

Soft x-ray angle-resolved photoemission study of $SrRuO_3$ thin films

Masaru TAKIZAWA*[1], Makoto MINOHARA[1], Akira CHIKAMATSU[1], Hiroshi KUMIGASHIRA[1], Atsushi FUJIMORI[1], and Masaharu OSHIMA[1]
[1]Univ. of Tokyo, Hongo, Bunkyo-ku, Tokyo 113-0033, Japan

Introduction

Broadly speaking, metal-insulator transition occurs in two ways [1]. One is bandwidth control, and the other is filling control. In bandwidth control, the bandwidth and hence electron correlation strength is changed by modifying the lattice parameter or the bond angle while essentially maintaining the original lattice structure. An example of bandwidth control is the modification of the radius of the *A* site ions in perovskite-type ABO_3 compounds.

Despite of their more extended 4*d* orbitals than the transition-metal 3*d* orbitals, ruthenates have been recently found to show various correlation effects. Previously photoemission study of $Ca_{1-x}Sr_xRuO_3$ thin films has revealed that the spectral weight transfer from the coherent part to the incoherent part in the Ru 4*d* t_{2g} band occurred with Ca doping, i.e., with decreasing bandwidth [2].

In this work we have measured soft x-ray angle-resolved photoemission spectroscopy (SX-ARPES) of $SrRuO_3$ (SRO) using high-quality epitaxially grown thin films.

Experiment

SRO thin films were fabricated in a laser MBE chamber connected to a synchrotron radiation photoemission system at BL-2C of Photon Factory [3]. The films were deposited on Nb-doped TiO_2-terminated $SrTiO_3$ (001) substrates [4] at 900 °C at an oxygen pressure of 0.1 Torr. The fabricated SRO films were transferred into the photoemission chamber under an ultrahigh vacuum of 10^{-10} Torr. The SX-ARPES spectra were taken at 20 K with the total energy resolution of about 200 meV at the photon energy of 600 eV.

Results and Discussion

The SX-ARPES spectra taken at 600 eV are shown in Fig. 1. Using the photon energy of 600 eV, one can trace momenta along the Γ (0,0,0) – X (π,0,0) line. As shown in the previous work [2], the bands between the Fermi level (E_F) to ~ -2 eV are mainly composed of Ru 4*d* character and those between ~ -2 eV to ~ -10 eV are mainly of O 2*p* character. There were clear dispersions both in the O 2*p* and Ru 4*d* bands as shown in Fig. 1. According to the previous work [2], one can observe the bulk electronic structure using high photon energy. Thus, the observed band dispersions should reflect the bulk electronic band structures. Near Fermi level, two bands crossing E_F were clearly observed.

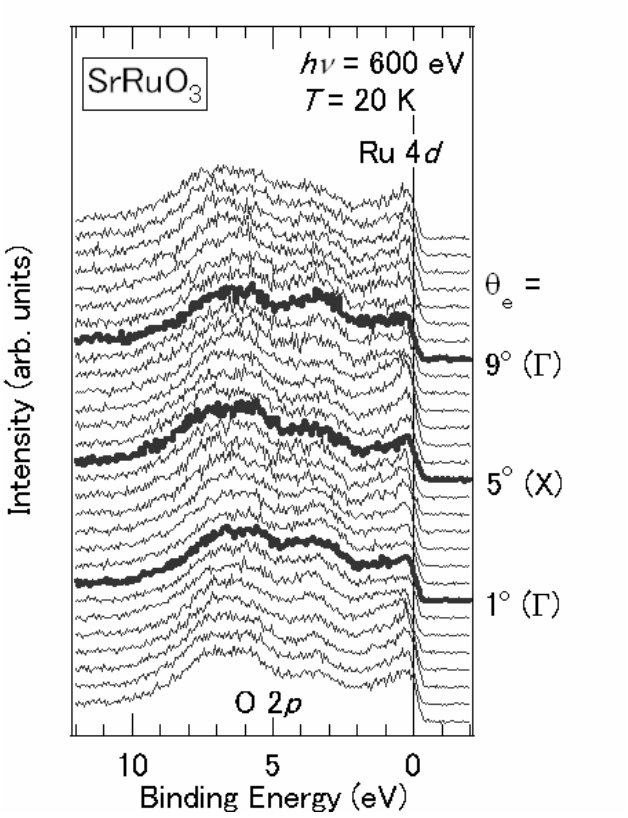

Figure 1: SX-ARPES spectra of SRO thin films.

References

[1] M. Imada, A. Fujimori, and Y. Tokura, Rev. Mod. Phys. **70** 1039 (1998), and references therein.
[2] M. Takizawa et al., Phys. Rev. B **72**, 060404 (2005).
[3] K. Horiba et al., Rev. Sci. Instr. **74**, 3406 (2003).
[4] M. Kawasaki et al., Science **266**, 1540 (1994).

*takizawa@wyvern.phys.s.u-tokyo.ac.jp