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Soft x-ray angle-resolved photoemission study of oxide superconductors

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We have tried to measure soft x-ray angle-resolved photoemission spectroscopy (ARPES) of high temperature superconductor $Bi_2.Sr_2CaCu_2O_8$ in order to study the kink in the dispersion and the superconducting gap. We found that it is difficult to get reasonable count within a given machine time due to very low intensity especially near the Fermi level (E_F) region. Therefor, we have measured angle integrated spectra across the transition temperature to concentrate on observation of the supercondcuting gap. But we found superconducting gap with the energy scale of several tenth meV can not be reliably studied because of a photon energy shift with the same order. To study the electronic structure near E_F of high temperature superconductors in detail with soft x-ray light, it is essential to get higher photon flux and to stabilize the photon energy more accurately.

On the other hand, we have performed photon-energy-dependent ARPES study of quasi-two-dimensional superconductor $CeIrIn_5$. We have successfully observed several dispersive bands with dominant In 5p character as well as a non-dispersive Ce 4f state which is ascribable to the Ce $4f^1_{7/2}$ final state originating in p-f hybridization. Furthermore, the observed In 5p bands unambiguously cross E_F along GM (ZA) line and form double cylindrical (Fermi surfaces) FSs around MA direction. The observed double cylindrical FSs have not been predicted by the itinerant f electron model band calculation where a single cylindrical FS has been expected [1]. However, we have checked the consistency of the sizes of the observed FSs with dHvA experiment [Y. Haga et al., Phys. Rev. B 63, 060503 (2001)]. The results point at the requirement for checking the theoretical existence of additional cylindrical FS.

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Relaxation and dissociation dynamics of inner shell resonant excited Formaldehyde molecule: Approach from ultra-high resolution angle resolved Auger / ion yield spectroscopy

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Inner-shell soft-x-ray absorption spectra and Auger electron emission spectra of formaldehyde, H_2CO, in the region of the O 1s ionization threshold have been studied with high energy resolution at BL27SU. The absorption spectrum was recorded via the total ion yield. The O 1s-excitation spectrum is dominated by an intense O $1s^{-1}$ π^* resonance at 530.8 eV and a series of weaker $1s^{-1}$ Rydberg states at higher energies. New vibrational structures on the intense O $1s^{-1}$ π^* resonance are revealed in the present high resolution spectrum. Angle–resolved Auger spectra of H_2CO have been recorded using a ultra-high resolution spectrometer (Gammadata-Scienta SES2002) installed at the BL27SU. Figure 1 presents a portion of the Auger spectra to the H_2CO^+ X $^2B_2$, A $^2B_1$, and B $^2A_1$ states via the O $1s^{-1}$ π^* state with vibrational excitation.

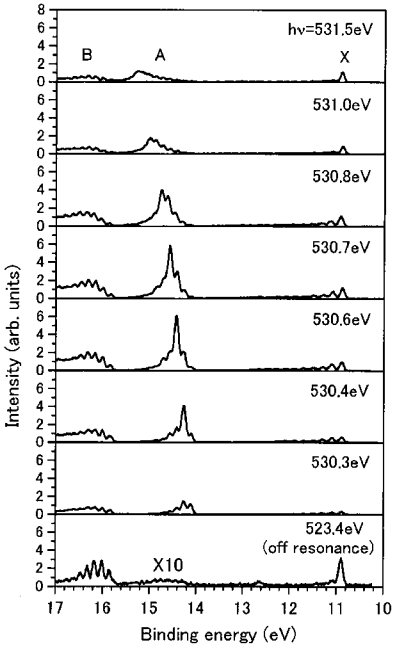

Fig.1 Resonant Auger spectra of H_2CO via O $1s^{-1}$ π^* resonance obtained at 0° directions relative to the polarization vector of the incident soft X-ray.