Tuning of 2-dimensional photoelectron spectrometer

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A high-resolution display-type spherical-mirror analyzer[1] is being tuned at BL25SU of SPring-8. This analyzer can display a 2-dimensional angular distribution pattern of particular kinetic energy electrons without distortion with high-energy resolution and with wide acceptance angle. The improved points (or the difference) of this analyzer compared with the previous one are; (1) the energy resolution improved from 1% of the pass energy to 0.1 % of it, (2) the acceptance angle expanded from $\pm 60°$ to $\pm 80°$, (3) the number of the obstacle rings increased from 27 to 261, (4) the diameter of the outer hemisphere increased from 30 cm to 60 cm, (5) we can change the size of the exit aperture from outside of the chamber, (6) The incident direction of the light has been inclined to 45° from the center of the analyzer, so that we can measure the photoelectrons at the polar angle range from $\theta = 0°$ to $\theta = 90°$.

The high-flux and high-energy resolved circularly polarized light of this beamline can be used to study the chemical-state resolved photoelectron diffraction or photoelectron holography. This study reveals the atomic structure on surfaces or the orbital angular momentum of photoelectrons[2].

Because the photoelectrons excited by circularly polarized light are spin polarized, the combination of this light and this analyzer enables us to study spin orientation of surface or bulk atoms by measuring circular dichroism in photoelectron diffraction.

The sample manipulator and sample carrier are specially designed and has been tuned for this purpose. The manipulator can move and rotate the sample with 5 independent degrees of freedom (x, y, z, θ, ϕ). The θ axis of rotation has been adjusted to be vertical, which was confirmed by the fact that it doesn't shift more than 0.1 mm when it rotates $\pm 180°$.

The sample carrier has six electrodes for various sample treatments, such as heating, measurement of the temperature, measurement of the resistivity, and so on. The position of the sample surface has been adjusted to lie on the θ axis. The orientation of the sample has been adjusted so that the surface normal direction to be perpendicular to the θ axis. The center of the sample carrier (i.e. the center of the carrier holder) has been set on the rotation axis of ϕ with an accuracy of 40 μ m.

The high thermal conductivity of the sample carrier enables us to cool the sample when we put a cooling vessel in the center of the manipulator in future.

[1] H. Daimon, Rev. Sci. Instrum. 59 (1988) 545. H. Daimon *et al.*,Rev. Sci. Instrum. 61 (1990) 57.
[2] H. Daimon, T. Nakatani, S. Imada, S. Suga, Y. Kagoshima, and T. Miyahara, Jpn. J. Appl. Phys. **32** Part 2, (1993) L1480.