Soft X-ray Spectroscopy of Solid (BL25SU)

1. Outline

BL25SU was designed focusing on the soft x-ray spectroscopy of solids with circularly polarized light. The goal of the resolving power E/ΔE was set to be greater than 10000. The beamline is equipped with three experimental stations in tandem. The first station is for photoemission spectroscopy (PES). The second station is for the magnetic circular dichroism (MCD) of soft x-ray absorption. The third station is for two-dimensional photoelectron spectroscopy (2D-PES).

2. Light Source

The light source of the BL25SU is called Twin Helical Undulator and is composed of two helical undulators mounted in tandem along the electron beam orbit. The helicity of the circularly polarized light is planned to switch using five kicker magnets to "kick" the electron beam orbit [1]. The commissioning of fast helicity modulation will start from 2001.

3. Monochromator

The grazing incidence monochromator employs varied-line-spacing plane gratings which operate on convergent light from a spherical mirror and focuses monochromatic light onto the exit slit [1]. The resolving power in excess of 15,000 was confirmed at 540 and 870 eV from the photoemission spectra of Au. The photon flux of more than 1×10^{11} photons/sec/100mA/0.02%b.w. is supplied onto the sample between 500 and 1,800 eV with a negligible amount of higher-order light (less than 0.1%). The first mirror Mh was mechanically bent leading to a horizontal light width of less than 0.5 mm at the third experimental station.

4. Experimental Stations

4.1 PES Station

A total energy resolution of 80 (±5) meV has been achieved at hν = 867.6 eV. This was estimated by the photoemission spectrum around the Fermi level of Au. The drastically improved resolving power in this photon energy region has revealed the detailed electronic structure of various compounds reflecting their bulk states [2].

4.2 MCD Station

An MCD spectrum is obtained by switching the direction of the magnetic field applied on a sample at each data point during an energy scan. The magnetic field of ~1.4 T is generated by a magnetic circuit composed of permanent magnets. The sample temperature can be changed from 20 K to room temperature. Ferromagnetic 3*d* transition metal compounds have mainly been studied at this station.

4.3 2D-PES Station

The first data of the 2D-PES station has been obtained for the photoelectron diffraction pattern of Si(001) surface. The observed pattern showed some fine structures that were not resolved in the previous pattern measured at AR in KEK [3]. The energy resolution of the analyzer was estimated as $E_K/\Delta E_K$ = 300 with angler resolution of ~0.6 degree. Some experiments have also been performed for W (011) surface.

References

[1] Y. Saitoh *et al.*, J. Synchrotron Rad. **5** (1998) 542.
[2] A. Sekiyama *et al.*, Nature **403** (2000) 396.
[3] H. Daimon *et al.*, Rev. Sci. Instrum. **66** (1995) 1510.

Light Source
Undulator period 120mm
Number of periods 12×2
Tunable energy range 0.22 - 3KeV
Brilliance 1.89-7.85×10^{17} ph/s/mrad^2/mm^2/0.1%b.w.
Total power < 1.67 kW
Power density < 3.0 kW/ mrad^2

Soft X rays at Sample
Tunable energy range 0.2 - 2 keV
Energy resolution E/ΔE >15000
Photon flux > 10^{11} ph/s/100mA/0.02%b.w.
Beam size < 2 mm^2

Experimental Stations
• Photoemission spectroscopy
• Magnetic circular dichroism of soft x-ray absorption
• 2D photoemission spectroscopy