Extremely Dense State Research (BL10XU)

1. Outline

The BL10XU beamline has an optical hutch and tandem experimental stations, a High Brilliance X-ray Absorption Fine Structure (XAFS) station and a High Pressure station. As a photon source, a standard in-vacuum-type undulator was installed at the low-β section in the SPring-8 storage ring. An intense X-ray beam with a selective energy above 6 keV has been obtained by the undulator gap tuning. The performance of this light source is summarized in Table 1. In September 1999, since the operating parameters of the storage ring were improved by the Accelerator Group in SPring-8, the quasi-high-β has been realized at the section of the BL10XU. In the optical hutch, the synchrotron radiation (SR) from the undulator was monochromatized by an Si(111) double crystal with a direct water coolant system at the 1st crystal. A rhodium coated double mirror installed just before the experimental stations can eliminate higher order harmonics light in a low energy region less than 15 keV.

The high brilliance XAFS station aims for XAFS measurement diluted systems such as impurities in the solids, surfaces, interfaces, and photo-excited processes. In the high pressure station, it is possible to perform powder X-ray diffraction under high pressures of up to 300 GPa generated by a diamond anvil cell. The activities of the instrumental construction in these stations are summarized below.

2. High Brilliance XAFS Station

In the High Brilliance XAFS station, fluorescence XAFS system with a Huber goniometer was introduced. It has a cryostat system that can control a sample temperature from ~15 K to room temperature. One of the advantages of this system is that the polarization-dependence of XAFS can be easily obtained by changing the azimuthal rotation angle while keeping the sample in the cryostat. The precise position controllability of the goniometer was also useful for the standing wave measurement of multilayer structures under low temperature conditions. For the measurements of X-ray fluorescence from the sample, a 7-element Si(Li) detector and a data acquisition system were installed. The development of a 100-element monolithic Ge detector is the next step to make this system sophisticated. The combination of a high brilliance X-ray beam and these multi-element detectors allows us to measure the XAFS spectra of very diluted atoms. The data processing for energy for energy dispersive analysis of fluorescence and photon counting are performed by the signal processors system (DXP, X-ray Instrum. Assoc.).

Since the quasi-monochromatized SR is obtained from the undulator, it is necessary to synchronize the gap control with the monochromator energy scan for XAFS measurements. New software to govern the gap control, monochromator energy, and signal detection by DXP, has been developed [1].

3. High Pressure Station

Another experimental station was designed for the study of high pressure X-ray diffraction. A sample is enclosed in a diamond anvil cell, which can generate high pressure, and the diffraction from the sample is detected by the imaging plate system. A chip style refractive x-ray lens for 2-dimensional focusing at the diamond anvil cell diffractometer position was installed in the transport section.When the x-ray energy was 17keV, peak flux density gain increased 12 times with a 120× 280 μm^2 focal spot size.

References

[1] H. Tanida *et al.*, in preparation for publication.

Table 1. Photon source specifications

Type	In-vacuum-type undulator
Undulator period	32 mm
Number of periods	140
Tunable energy range	> 6 keV
Brilliance	6×10^{19}ph/s/mrad^2/mm^2/0.1% b.w. at14.4keV
Total power	5 kW
Power density	300 kW/mrad^2