Structure Biology II (BL40B2)

1. Introduction

We have completed the initial commissioning of the beam transport and experimental station for small angle X-ray scattering and protein crystallography at a new beamline BL40B2 in the D zone of SPring-8.

The fundamental concept for the beamline is to utilize the SPring-8 bending magnet beam in two different experimental fields including the area of small-angle scattering from non-crystalline biological materials and the area of crystallography of biological macromolecules with routine and easy operation from the view point of general users. Because the experimental modes provided in this experimental station are in the opposite direction to the files of small angle X-ray scattering, very small angle scattering toward the direct beam should be recorded to obtain a long term repeat while in the process of protein crystallography, high Bragg angle diffraction spots are required to achieve a high resolution structure analysis. The present beamline has single an X-ray source and two experimental modes.

2. Beam Supplied to the Experimental Station

The location of BL40B2 is in the D zone of the SPring-8 storage ring. The light source is a B2-type bending magnet (BM2). The white X-ray generated by the bending magnet is introduced into the beam transport which includes a fixed-exit double crystal monochromator (MN) at 35520 mm from a light point of BM2 and bent-cylinder mirror (M) at 38015 mm. The calculated optimal glancing angle is 3.2 mrad at a distance between the light source and miller of 38015 mm and in an energy range of from 5 keV and 20 keV. The expected photon flux is approximately 10^{12} ph/s in 0.1 % b.w. at 20 keV. The expected energy resolution is 10^{-4} ($\Delta E/E$).

Light Source	
Type	Bending magnet
Critical energy	28.9 keV
Source size	σ_x = 0.18 mm σ_y = 0.06 mm $\sigma_{y'}$ = 0.06 mrad (@ 10 keV)
Horizontal beam divergence	1.5 mrad

X-rays at Sample	
Energy range	5~25keV
Usable Energy	8~18keV
Energy resolution	$\Delta E/E = 10^{-4}$
Photon flux	
	10^{12}ph/s in 0.1%b.w. at 20 KeV Monochromatic
	10^{11}ph/s in 0.1%b.w. at 12 keV Monochromatic

3. Experimental Station

The experimental station is approximately 2.4 m long and 1.2 m wide. The station carries a shutter box containing 4D-slit and attenuation plates, beam path, elevator gonio-unit, detector unit, and cryo-stream unit. The experimental station has two experiment modes including the SX (small angle X-ray scattering) mode. To limit the beam, a four-dimension (4D) slit is installed upstream of the monochromator at 33645 mm and two 4D slits are installed in the downstream of miller, 41080 mm and 50530 mm. The optics and experimental facilities have been made X-ray proof by lead sealed hutches of the separate type. The front optical hutch covers beam transport MN and M up to 42000 mm and the aft experimental hutch from 50000 mm harboring final slit and experimental station and PX (protein crystallography) mode. In both modes, the common detector is an imaging plate area detector, Rigaku R-AXIS IV^{++}. In the SX mode, the X-ray beam is orthopediated by an extra quadrant slit in the beamline optics and excess scattering is removed by the quadrant slit in the experimental station. Two fixed length vacuum paths allow camera lengths of 400 mm and 1000 mm. In the PX mode, an inverted geometry goniometer is installed to allow some free space around the crystal.

4. Commissioning

Commissioning has started with the off-line adjustment of every single moving axis in the beam transport. Simultaneously with this work, control and communication software has been developed. After clearing the X-ray safety issues, on-line commissioning has been carried out. Major load have paid for the monochromator adjustment and slit work to obtain a fine tune beam with preventing parasitic scattering. As a result, fix-exit beam covers between 8 keV and 18 keV have obtained approximately 10^{11} ph/s with an energy resolution of 10^{-4} ($\Delta E/E$).

Facilities in the Experimental Station
A. Measurement
Quadrant slit, Shutter attenuation Gas-flow type ion chamber, Beam path with down stream shutter
On-line detector:
Rigaku R-AXISIVV^{++} area 300×300 mm^2
ADSC Quantam 4R area 188×188 mm^2
Sold counter for the measurement of absorption edge
High speed X-ray shutters
B. Sample
Sample stage Cryostat, temperature control range 80~375K
C. Control
Workstation for control and data collection
D. Others
Automated crystal centering and axis-set Microscope