White Beam X-ray Diffraction (BL28B2)

1. Introduction

Beamline BL28B2 was designed for the wide use of white synchrotron x-radiation from a bending magnet. Almost all components, which are front-end components, hutch and optics components, were set up in the beamline in the first half of 1999. In the eighth cycle, we operated the commissioning and ran the synchrotron beam in the experimental station, and succeeded it with no trouble. In the last half we installed the experimental apparatus in the experimental hutch and side rooms. It was precisely tuned for the purpose of the white x-ray topograph. Some experiments are already in operation.

2. Beamline

Beamline components and their arrangement are very simple as shown in Fig.1. Their combination is so unique that neither monochromator nor mirror is installed in the optics hutch. However, we can arrange various optical components in the experimental station if necessary. The available x-ray energy is from 3 keV to more than 100 keV. The lower limit is affected by absorption by beryllium windows to divide the vacuum sections. The size of the beam at the main diffractometer is 10 mm in vertical and 50 mm in horizontal when the transport channel slit fully opens.

3. Experimental Station

All the station equipment for this beamline is designed to perform white and selected bandwidth X-ray topography as well as micro beam imaging, scattering topography, high/low temperature topography including various applications using white beam diffraction experiments for the third generation light source.

Figure 2 shows the layout of the experimental station at BL28B2.

The facility elements (absorber/filter, water absorber, fast shutter, additional optical system, micro beam scanning system, main diffractometer, high/low temperature specimen stages) have been individually designed in order to perform various kind of topographical experiments.

The absorber/filter is composed of a slow shutter and five different kind of metal absorbers.

The slow shutter is made of a lead plate 15mm thick and is operated with 0.1 sec time resolution.
The metal absorbers are two aluminum absorbers (5mm and 2mm thick), two copper absorbers (2mm and 1mm thick) and one iron absorber (1mm thick).
The water absorber is used for the observation of organic crystal. Water absorbs X-rays with an energy band, which damages organic crystal. The length of the water path can gradually change from 10mm to 50mm.

The fast shutter is a 10 msec controllable shutter measuring 5 by 5 mm^2.

The additional optical system extracts X-rays in an

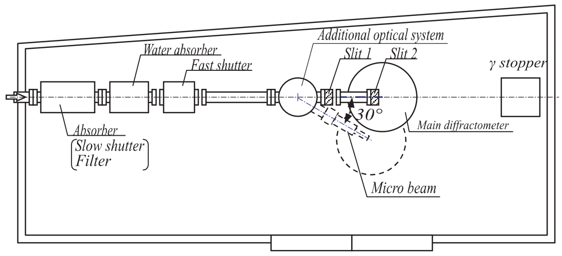

Fig. 2. Layout of the experimental station at BL28B2.

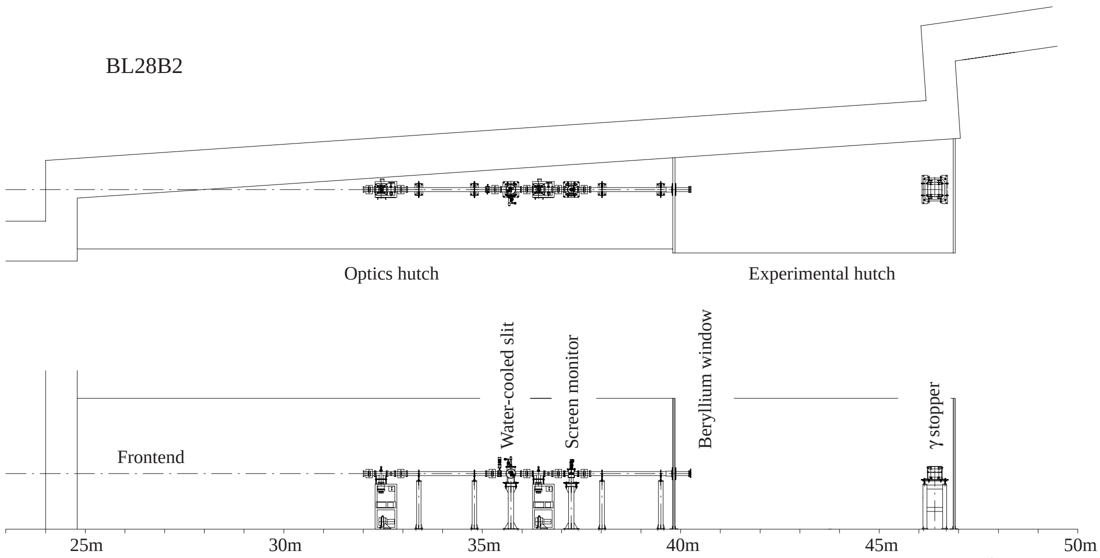

Fig. 1. Layout of beamline 28B2.

energy band from 10^{-3} to 10^{-2} of dE/E by monochromators.

The micro beam is made by a 0.1mm or a 0.04mm diameter pinhole.

The main diffractometer is mounted on a long translation stage to match the rotation center to the incident X-ray beam. The base goniometer is on a vertical axis ω-2θ. Another ω-2θ goniometer with a horizontal rotation axis is mounted on the vertical 2θ table. A goniometer head to adjust the sample orientation is mounted on the vertical ω table. The goniometer head has xyz translation and two crossed tilting mechanisms. A translation stage to mount a detector such as an X-ray TV is attached to the horizontal 2θ table. The performances of these segments are shown in Table 1. The maximum load of the main diffractometer is designed to be more than 100 kgf, so the various devices used to control the sample environment have been adapted accordingly. Figure 3 shows the main diffractometer.

Table 1. Axes of main diffractometer

	name	resolution	movement range
1	ω1 stage	0.001 deg	±180 deg
2	2θ stage	0.001 deg	±180 deg
3 4	X-Y stage	0.002 mm	±20 mm
5 6	R_X-R_Y stage	0.001 deg	±7.5 deg
7	Z stage	0.0002 mm	±20 mm
8	χ stage	0.001 deg	±180 deg
9	Detector translation stage	0.002 mm	±200 mm
10	ω2 stage	0.001 deg	±180 deg
11	Translation stage	0.002 mm	800 mm

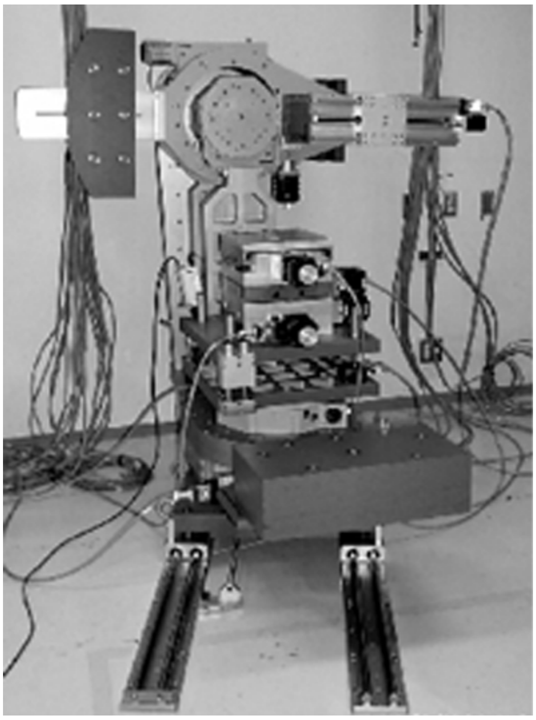

Fig. 3. Main diffractometer.

The high/low temperature specimen stages control the sample environment.

The high temperature specimen stage uses an infrared heater with a temperature range between room temperature and 1700K and a stability of ±0.1K. To avoid oxidation of the sample, the chamber for the sample is evacuated with a turbo-molecular pump. A sample orientator with two motorized rotation axes and a manual translation axis are used with the stage.

The low temperature specimen stage uses an He cryostat system with a temperature range between liquid helium (3.8K) and room temperature and a stability of ±0.1K. A manual full circle orientator is used with the stage.

Conventional detectors (an ionization chamber and a NaI detector) are used as SPring-8 standards to adjust the sample orientation. X-ray films, emulsion plates and an X-ray TV system (HX-260 HITACHI Denshi, Ltd.) are currently being considered as imaging detectors.

The control system for this beamline is the SPring-8 standard system.

Light Source	
Type	Bending magnet
Source size	σ_x=0.146 mm
	σ_y=0.236 mm
	$\sigma_{y'}$=0.920 μrad

X-rays at Sample	
Energy range	lower limit:3 keV
	(due to Be windows)
	upper limit: more than 100keV
Beam size	50 mm^H, $10mm^V$

Facilities in Experimental Station

- Main diffractometer
- Additional diffractometer
- Intensity measuring devices
- Image reccording devices
- Infrared heater
- Control systems