APCST BM (BL12B2)

1. Introduction

The BL12B2 beamline is part of the Taiwan X-ray facility at SPring-8, which includes two contract beamlines BL12B2 and BL12XU. The contract is arranged under APCST as SRRC's operational agent in Japan. The BL12B2 is designed for multi-purpose applications, including micro-diffraction, protein crystallography, X-ray absorption spectroscopy and high resolution X-ray scattering. In this report, we briefly describe the beamline design and our scientific plans. A detailed discussion of the beamline design is given in Ref. [1].

2. Scientific Program

The present synchrotron X-ray facility in Taiwan is based on three wiggler beamlines on the 1.5 GeV Taiwan Light Source. The BL12B2 beamline at SPring-8 is designed to complement the existing TLS facility to enhance research capabilities in hard X-rays for Taiwan users in advanced materials and structural biology. The research programs at SPring-8 will be emphasized on what can be benefited most from the high energy X-rays and the brightness of the source at SPring-8. At present, four classes of research are planned for the BL12B2 beamline.

a. *X-ray Absorption Spectroscopy (XAS) In-situ* transmission and reflectivity XAS techniques are being employed for the investigation of various catalysts and battery materials at SRRC. Biologists and environmental scientists are applying XAS to study dilute samples, e.g. metallo-proteins. The BL12B2 beamline will provide the high-energy part of the spectrum for these studies. A multi-element solid state detector will be installed.

b. *Protein crystallography (PX)* will be one of the major applications on this beamline. The PX end station will provide multiple wavelength anomalous dispersion (MAD) and high-resolution capabilities. In addition, the equipment for multiple diffraction will be developed for X-ray phase determination in protein crystals.

c. *High resolution X-ray scattering* will be carried on a conventional six circle diffractometer. Sample stages such as cryostate, cryomagnet, and detectors for real-time measurements will be installed. Material systems of interest include high Tc superconductors, thin films, nano-structure materials, *etc*.

d. *Micro-diffraction / micro-probe* will utilize micro-focusing optics to produce a micron size beam for applications in high-pressure studies and X-ray tomography. Micro-diffraction will be developed at a later stage for the studies of nano-structure materials.

3. Beamline Overview

To fulfill the maximum spectral requirements for various disciplines, this beamline will be capable of functioning in one of the following operation modes: (1) white beam mode, (2) monochromatic beam in medium energy range ($5 < E < 25$ keV) with high energy resolution ($\Delta E/E \cong 10^{-4}$), (3) monochromatic beam in high energy range ($25 < E < 70$ keV) with high energy resolution ($\Delta E/E \cong 10^{-4}$).

The design of this beamline was based on the general approach taken by most generic SPring-8 BM beamlines, Several modifications to major optical components were adopted to provide operational modes for both white beam and monochromatic beams from 5 keV to 70 keV. As shown in Fig. 1, the beamline layout consists of three major optical components: a collimating mirror (CM), a double crystal monochromator (DCM), and a focusing mirror (FM). Many standard SPring-8 beamline transport components were adapted in order to reduce design work.

The CM, located 28.92 meters from the source, provides the necessary functions of beam reflection, beam collimation, high ordered harmonic suppression, and thermal power reduction. The CM is made of silicon block and is water-cooled to effectively dissipate a total thermal loading of 200 watts. Two different surface stripes, Rh-coated and bare Si (non-coated), are prepared for different experimental needs.

The standard SPring-8 adjustable-inclined DCM [2], located 34.3 meters from the source, is used to select photon energy between 5 keV to 70 keV. The sagittally bendable crystal horizontally focuses the photon beam at various sample positions. The DCM can be operated under a quick scan mode with a speed

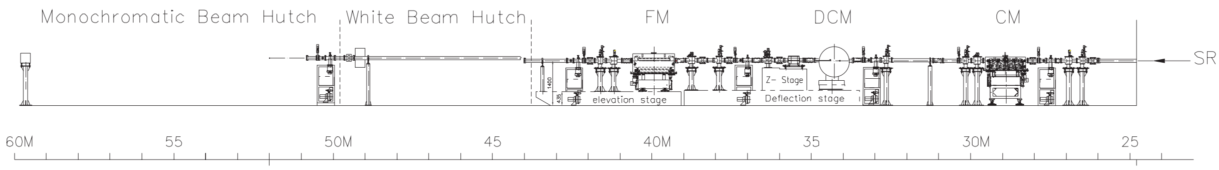

Fig.1. BL12B2 beamline layout

of 1°/sec, or roughly 1keV/sec to make Quick-EXAFS for real-time measurements possible. The quick scan has been accomplished by reducing the weight of the DCM rotating stage, locking together the first and second crystals (pseudo channel-cut mode), and using an AC servo instead of a stepping motor to drive the main rotation stage.

The FM, located 39.35m from the source, is a bendable cylindrical mirror which reflects and focuses the photon beam vertically to the sample position. There is no cooling required for this mirror, since most of the radiation power has been removed by the collimating mirror and monochromator.

All optical components are in place while the beamline is operated in medium energy monochromatic mode. For the high-energy monochromatic beam mode, both mirrors are moved away from the optical path. While the beamline is operated in the white beam mode, all three major optical components are moved away from the optical path. Changing between different beamline operational modes can be accomplished through two deflection/elevation stages. The detailed design of these stages may be found in [3].

4. Schedule

The beamline construction has been progressing smoothly. The beamline conceptual design was completed in October 1998. The beamline front end was installed into the SPring-8 storage ring in August 1999. The radiation enclosures and utilities covering both BL12B2 and BL12XU were completed in May 2000. Most of the beamline optical and transport components are either installed or waiting to be installed at SPring-8 site. The beamline is scheduled to take synchrotron lights in the fall of 2000 and beamline commissioning will take place afterwards.

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References

[1] M.-T. Tang *et al.*, SRRC Internal Report, SRRC/RBM/IM 98-03.
[2] T. Ishikawa, SPring-8 Annual Report 1996 (1996) 30.
[3] S. Goto *et al.*, J. Synchrotron Rad. **5** (1998) 1202.

Light Source	
Type	Bending Magnet Source (B2)
e-beam size:	155 μm (horizontal)
	50 μm (vertical)
e-beam divergence:	110 μrad (horizontal)
	2.8 μrad (vertical)
horizontal acceptance:	1.5 mrad
X-rays at sample	
Energy Range	5-70 keV
Energy Resolution	10^{-4}
Photon Flux	10^{11}-10^{12}/sec
Beam Size	723μm (H)×179μm (V) @ 20keV

Facilities at Experimental Stations

- Conventional Huber 6-circle diffractometer
- Off-line Mac Science image plate reader
- CCD detector for PX
- Pre-figureed K-B mirrors
- Lytle detectors
- Cryostat
- Polarization chamber