BL12B2
Asia and Pacific Council for Science and Technology (APCST BM)

1. Introduction

A contract bending magnet beamline BL12B2 newly constructed by APCST (Asia and Pacific Council for Science and Technology), Taiwan, has been able to deliver superior synchrotron x-ray beams to the experimental hutch since October 2000. The combinations of different configurations of Doulde crystal monochromator (DCM), collimating and focusing mirrors allow the x-ray energies to be varied from about 7 to 80 *KeV* with an energy resolution about $\Delta E/E \sim 10^{-4}$. This is a multi-purpose beamline for the bio-structure and materials researches. At present the experimental hutch is equipped with a multi-functional experimental stage for the EXAF and powder diffraction experiments, and a 6-circle diffractometer for the x-ray scattering and diffraction measurements. After the summer shutdown of year 2001, a new stage, a joint research project between JASRI and APCST, for the studies of protein crystallography will be installed into the experimental hutch and the commissioning will start thereafter. In this article, we report the progress and performances of Taiwan Contract Beamline BL12B2 in the first period of year 2001.

2. Beamline Construction

The construction of the beamline had been firmly carried out by the end of year 2000. The installation of the transport components (Kobelco) was started in the late of June of the year, whilst the double crystal monochromator (Kohzu Seiki) and two mirror systems (Oxford Instruments) were shipped to SPring-8 and installed into the beamline in June and August, respectively. By the end of August, all the beamline hardware had been in position and well aligned. Subsequently the interlock system (Hitachi Zosen), cabling and wiring started in mid-August and completed four weeks later. The whole beamline was ready for safety and radiation test by the end of September.

Under the coordination of SPring-8, people from SPring-8, Taiwan and hutch manufacturer participated in the radiation and safety test started from the first week of October. An essential milestone of the beamline history was marked at the very moment when the first synchrotron light was delivered to the experimental hutch on October 4. The official safety approval was issued on October 13, and thereafter the beamline was allowed for operation.

The completion of this first Taiwan beamline at SPring-8 has pushed up the scope of utilization of photon beams to a brand new era for the research communities in Taiwan. A dedication ceremony co-chaired by the Chairman of Taiwan National Science Council and the Present of JASRI for the completion of this beamline was held on December 15, 2000 at SPring-8.

3. Performance of Beamline

The beamline can be operated in four different modes to fulfill the maximum spectral requirements for various experiments. The change between different operational modes can be accomplished by switching the configuration of the deflection and elevation stages, and the beamline optical components. For details of beamline design, please refer to [1].

The collimating mirror provides the functions of collimation of x-ray beams, heat load reduction and the suppression of high harmonics. The collimating mirror was initially off-line calibrated by using SPring-8 newly equipped long tracing profilometer (LTP) and subsequently pre-bent before installing into the vessel. The focusing mirror, however, normally operating face-down, was not calibrated by LTP.

The DCM is a standard SPring-8 adjustable inclined monochromator [2]. A pair of Si(311) crystals were used as the diffractive objects so that the energies can be tuned from 6 *keV* to 100 *keV* by selecting the different diffraction planes of (111) to (511). In the commissioning period, the AC servo of the DCM was found to induce the unacceptable fluctuations to the beams as scanning the energy. In order to improve the stability of beams, this AC servo has been replaced with a normal stepping motor.

The monochromatic x-rays are focused horizontally by the 2nd crystal being sagittally bendable. The focus in the vertical direction is accomplished by the meridionally bent focusing mirror. Although the focusing position can be largely changed, the beam spot is mostly focused at the center of the diffractometer, 54 meters away from the source. The horizontal beam size was measured to be 3 mm which is intrinsically limited by the physical dimension of the rib-shaped 2nd crystal [3], and 0.15 mm for the vertical beam size.

During the commissioning, several major sources from beamline components have been identified to be responsible for the instability of the beams. These included the fluctuations generated from the water tube connecting to the crystals holders of the DCM (several percents initially), the AC servo, the third harmonics of beams, especially while operating the beamline in low energy regime. These faults have been properly improved. An unexpected effect found, especially in high energy regime, was the multiple diffraction (MD) from other atomic planes. The intensity competition between the primary reflection and secondary reflections results sharp intensity variation (several percents) to the primary beam thus the impinging photons used for an experiment. For most experiments, except those polarization dependent anomalous measurements, this MD effect, however, can be properly normalized.

The photon flux was measured to be about 5×10^{10} photons/sec by ionization chambers in the energy range from 10 to 22 keV using Si(311) for DCM with beams spot 0.2×3 mm^2.

4. End Stations

In parallel to the beamline construction, the set-up of the experimental end stations was planed and then completed. A multi-functional experimental stage for EXAFS and x-ray powder diffraction and a conventional six-circle diffractometer were installed into the experimental hutch by the end of September 2000. These end stations consequently were adopted to characterize the beamline performance in the beamline commissioning period. In order to free the Taiwan users from trouble of unacquaintance to SPring-8 experimental environment, the end stations are designed mostly similar to the ones operated in Taiwan. A *spec*®(Scientific Certificate) program and the VME hardware system are adopted to be the main control system and for data acquisition.

Several groups in various research fields from Taiwan were invited to join the commissioning works. Several further sophisticated experiments are thereafter planed.

(1) EXAFS

The EXAFS end station (*Fig. 1*) is equipped with ionization chambers, Ge(Li) solid state detector and Lytle detector. Standard foils were initially utilized to characterize the properties of the beams for the EXAFS experiments. Various measurements on different systems including high TC superconductors (W. F. Pong), bimetallic nano-particles in microemulsion (B.J. Hwang) and in mesoporous molecular sieves (K. J. Chao), nano-particles under high pressure phase transition (J. M. Lin), dilute environmental metallic contamination (K. S. Lin), etc., were in term carried out.

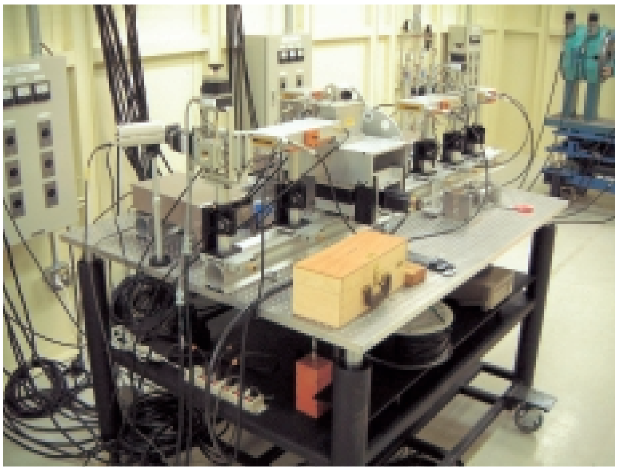

Fig. 1 The experimental stage for the EXAFS and powder diffraction measurements. The 6-circle diffractometer is placed behind the stage.

(2) Powder X-ray Diffraction

The powder x-ray diffraction can be carried out on the beamline either using a conventional Huber 6-circle diffractometer or an image plate setup (Mac Science DIPR-420). A charge density study of the Fe-phen spin crossover complex has specifically been carried out to test the performance of setups (Y. Wang). A feasibility study of high pressure powder x-ray scattering was also conducted at the pressure around 30 GPa using diamond avil cell (J. M. Lin).

(3) X-ray Scattering

The spatial resolution of the beamline was characterized on the conventional Huber 6-circle diffractometer with two perfect Si (111) crystals, one used for the sample and the other one for the analyser. The resolution was measured to be as high as 10^{-4} Å^{-1}. Several experiments on the studies of the thin films (C. H. Lee), semiconductor quantum wells (D. Y. Noh), Si/SiO2 interface (S. L. Chang), charge density waves (C. H. Du) and DAFS (H. H. Hung) have been carried out. In addition to a cryostat (8 K to 350 K) and various detectors available at the moment, a polarization chamber will be also available by the end of year 2001.

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