New Apparatus & Upgrades

Upgrade at Hyogo Prefectural Beamline BL24XU

BL24XU is the first contract beamline at SPring-8 constructed by Hyogo Prefecture in 1997. For the first decade, the beamline has been operated with the primary mission of promoting synchrotron radiation use to industrial application. The first mission is successfully completed by reviewing the present prosperity for industrial use of synchrotron radiation such as the advent of many exclusive beamlines. We instituted a new mission of industrial contribution for the next decade that aim at providing highly advanced techniques for nanoscience. In this report, beamline upgrade at BL24XU for the new mission is introduced.

BL24XU consists of a hard X-ray undulator source and four experimental hutches. The undulator of the figure-8 type can provide intense X-ray containing every half-order harmonics with each alternative linear polarization. In the first decade configuration, we divided X-ray beam into three branches (A, B, C) by two sets of beam-splitting monochromators. The monochromators have a configured long-offset (2 m) double-crystal geometry using a thin diamond crystal as the first crystal. Branch-A has an end station for protein crystallography experiments, and branch-B has end stations composed of a powder diffractometer and a gas-environed grazing incidence diffractometer for materials science. For the most downstream branch, namely, branch-C, a silicon double-crystal monochromator has been installed to share X-rays with the tandem experimental hatches C1 and C2 for nanobeam application and microbeam diffraction, respectively (C2 was constructed in 2004). The nano/microbeam techniques developed as scientific research by X-ray Optics Laboratory at the University of Hyogo are highly advanced subjects and the demands for the techniques are getting higher. On the other hand, the roles of end stations A and B will stop with the development of other beamlines for the industry. Then, we reconfigured the beamline in 2008 to develop nano/microbeam technique and to give new functions for new application works.

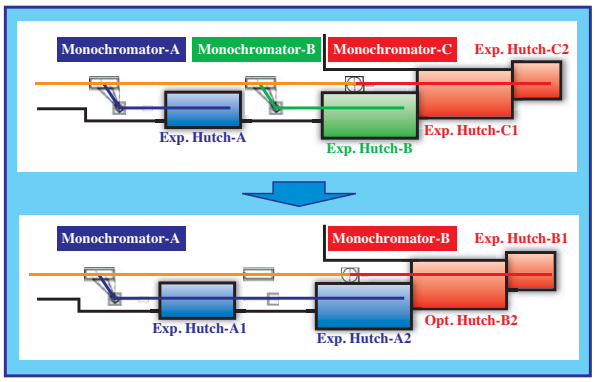

Fig. 1. Schematic upgrade at BL24XU.

Figure 1 shows the beamline configuration before/after the beamline upgrade. One of the beam-splitting monochromator for branch-B was removed and the experimental hutches between A and B was connected by a wide beam transport pipe. The pipe was installed in optical hutch and had to be completely shielded with a 20 mm-thick lead layer. These reconstructions were finished in March 2008. Consequently, we can use a very long experimental setup with tandemly arranged experimental hutches, which were renamed A1 and A2. The previous branch-C was also renamed branch-B. The large propagation length of new branch-A can be used not only for focusing beam but also as a 16-m-long USAXS instrument. The rearrangement of conventional diffractometers has already been completed and opened to use. New apparatuses for USAXS and micro-SAXS are under construction. And GISAXS and Bonse-Hart type SAXS are being planned.

The improvement of nano/microbeams is also an important subject, though a focusing beam with a size of approximately 100 nm is now practical. We are studying a new beam-splitting monochromator that does not disturb the X-ray wavefront to branch-B. For the first crystal of the monochromator an amplitude division type using a thin sapphire single crystal or a wavefront division type using sectioned silicon substrate are being evaluated. Furthermore, new focusing devices using a multilayer technique have been developed to improve both focusing size and efficiency.

The above-mentioned new apparatuses at branch-A, including nano/microbeam optics at branch-B, will help to analyze nanostructures in both real and reciprocal spaces, and will provide powerful complex tools for nanoscience with its operation with another Hyogo prefectural beamline BL08B2.

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