BL27SU
Soft X-ray Photochemistry

1. Introduction

BL27SU is a soft X-ray undulator beamline dedicated to soft X-ray spectroscopy and microscopy under normal ambient pressure (helium) or high-vacuum conditions. The beamline consists of two branches. The C-branch, which is equipped with a varied-line-spacing plane grating monochromator (VLP-PGM), provides lower soft X-ray radiation in the range from 0.17 keV to 2.2 keV. The VLS-PGM installed in the C-branch was upgraded in FY2018 [1].

The B-branch provides a higher-energy soft X-ray (2.1–3.3 keV). Radiation from the undulator is monochromatized using a Si(111) channel-cut monochromator and is focused to about a 10-μm spot on the sample position using Kirkpatrick-Baez (KB) mirrors [2, 3]. The main experiments performed in this branch are XRF elemental mapping, XRF/XAFS chemical mapping, and μ-XAFS measurements using focused soft X-rays. Here, we report the upgrade of the end-station of the B-branch in FY2019.

2. Upgrade of the end-station of the B-branch

2.1 Installation of a high load capacity stage

A channel-cut-type monochromator is installed on the B-branch. Because it changes the photon beam height due to the rotation of the Si-crystal block, the height change must be eliminated to use as a fixed-exit-type monochromator. For this purpose, equipment installed downstream of the monochromator is mounted on a single stage, and the stage automatically adjusts the height position of the chamber to the photon beam by synchronizing it to the rotation of the Si-crystal block.

Due to the limited number of undulator beamlines available in this energy region, the number of proposals for this branch continues to increase. Proposals request to use not only the built-in equipment but also users' own equipment. Unfortunately, the low load capacity of the conventional stage limited acceptable equipment. In FY2019, a new stage with a high load capacity was installed and the end-station of the B-branch was upgraded.

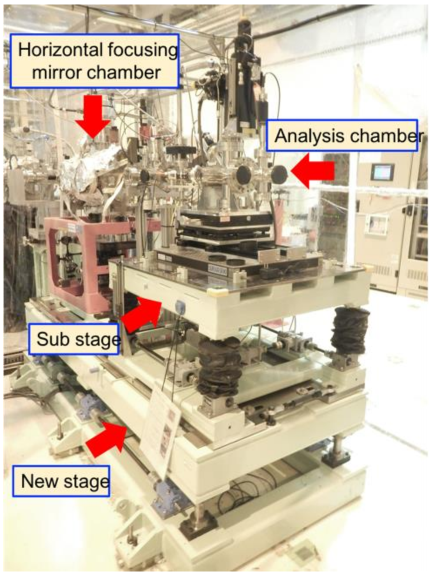

Fig. 1. Photograph of the new high load stage installed on the B branch of BL27SU.

Figure 1 shows a photograph of the newly installed end-station equipped with a high load stage. The stage at the bottom of the apparatus is the newly introduced part. The installation of an independent small stage (sub-stage) allows a user's chamber to be installed with a height from the floor to the optical axis in the range of 100–500 mm. The load capacity of the new stage is about 1,500 kg. The accuracy of the height correction is less than the beam size (~10 μm). Measuring the excitation energy change in an XAFS measurement confirmed that the sample position can be corrected. After installing this stage, three proposals using users' equipment were performed in 2019B.

2.2 Installation of a constant-temperature booth

To achieve a high performance in imaging experiments, the beamline must be operated under the stable condition. In contrast to the hard X-ray beamlines, which have their own experimental hutch, the end-stations installed on soft X-ray beamline are exposed in the Experimental Hall. Therefore, the experimental stations and optical chambers are susceptible to temperature changes, which lead to beam instability. To suppress beam drift due to thermal changes of the optics chamber and stage, a constant-temperature booth was installed in FY2019.

Figure 2 shows a photograph of the newly installed temperature-controlled booth. The booth is comprised of an aluminum frame and vinyl sheet (PVC: polyvinyl chloride, t =0.15 mm). The booth is separated into two parts. The first part houses the vertical focusing mirror chamber and Si(111) channel-cut monochromator. Because these apparatuses are operated by a remote control, the first room is usually kept at a constant temperature. The second part houses the high load stage described in the previous section. A vertical mirror, differential pumping system, and analysis chamber are mounted on the stage. Since the user must enter the booth to change the sample, this environment is controlled separately.

Before installing the constant-temperature booth, the beam position shifted about 12 μm and 4.5 μm in the vertical and horizontal directions over 5 h, respectively. After installing the booth, beam instability has been significantly improved, and the total drift over 10 h was 1 μm and 0.5 μm in the vertical and horizontal directions, respectively.

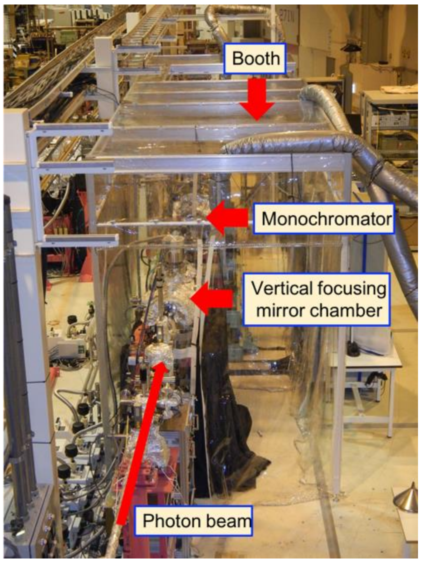

Fig. 2. Photograph of the constant-temperature room installed on the B branch.

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References:

[1] Tsuruta, K. and Tamenori, Y. (2018). *SPring-8/SACLA Annual Report 2018*, P56.

[2] Tamenori, Y., Muro, T. and Kinoshita, T. (2010). *SPring-8/SACLA Annual Report 2010*, P 74.

[3] Tamenori, Y., Muro, T. and Kinoshita, T. (2012). *SPring-8/SACLA Annual Report 2012*, P 69.