BL03XU
Advanced Softmaterial

1. Introduction

BL03XU is managed and operated by an industrial and academic joint organization (advanced soft material beamline consortium: FSBL). Considering the fact that BL03XU is to be used for industry–academia collaboration, the maintenance of BL03XU was carried out with an awareness of production, which is a category of “aiming for high performance and high throughput”.

In BL03XU, small-angle X-ray scattering/ wide-angle X-ray scattering (SAXS/WAXS), Ultra-SAXS, μ-beam SAXS/WAXS, grazing-incident (GI)-SAXS/WAXS, and X-ray photon correlation spectroscopy are performed. In the SAXS/WAXS measurement, there are several types of measurement such as SAXS/WAXS simultaneous measurement, SAXS/WAXS switching between camera distances of 0.2 and 4 m, and a change of the equipment around the sample. By reducing the adjustment time as much as possible, we aimed to increase the effective user beamtime that contributes to the measurement and achieves high throughput. In addition, by achieving a small process and automation of the layout change, it is possible for the user to set up the system by himself, and experiments can be performed with a sample-dependent measurement schedule instead of a layout-dependent measurement schedule. The following is an overview of the labor-saving efforts for each item.

2. Labor-saving layout changes around the sample

BL03XU is capable of SAXS/WAXS measurements with a camera distance of 0.2 to 4 m, as well as measurements with large equipment. In addition, users bring in and install various devices around the specimen for in situ measurement each time they conduct an experiment. The layout of these devices is changed several times a day. These changes and adjustments can take several hours, and some of them require the work of BL personnel. This time, we have achieved a fully automated system that can change the distance between the sample and the detector (camera distance) and the space around the sample easily.

Figure 1 shows the overall picture of the sample area and the vacuum pipe apparatus, as well as a picture of the modified layout of the sample area. From the beryllium window downstream of the optics hatch to the silicon nitride window just in front of the sample, the same vacuum is used to minimize the background increase from the extra window material and air scattering. The scatterless slit, which is placed directly upstream of the sample to eliminate parasitic scattering, is connected to the upstream section by a telescopic bellow. A linear shaft is installed in the telescopic bellow to prevent the bellow from bending. By manually turning the handle, the space around the specimen can be easily changed from 0 to 400 mm without leaking the vacuum. The specimen mount with linear guides is adjusted to an accuracy of about ±0.2 mm with respect to the optical axis, so there is almost no need to adjust the optical system when changing the space around the specimen. This allows the layout around the specimen to be changed completely by the user, and the time required for the layout change is only about one minute.

Changing the camera distance in SAXS measurement is achieved by changing the distance between the detector and the sample by changing the length of the vacuum pipe shown in the blue frame in Fig. 1(a).

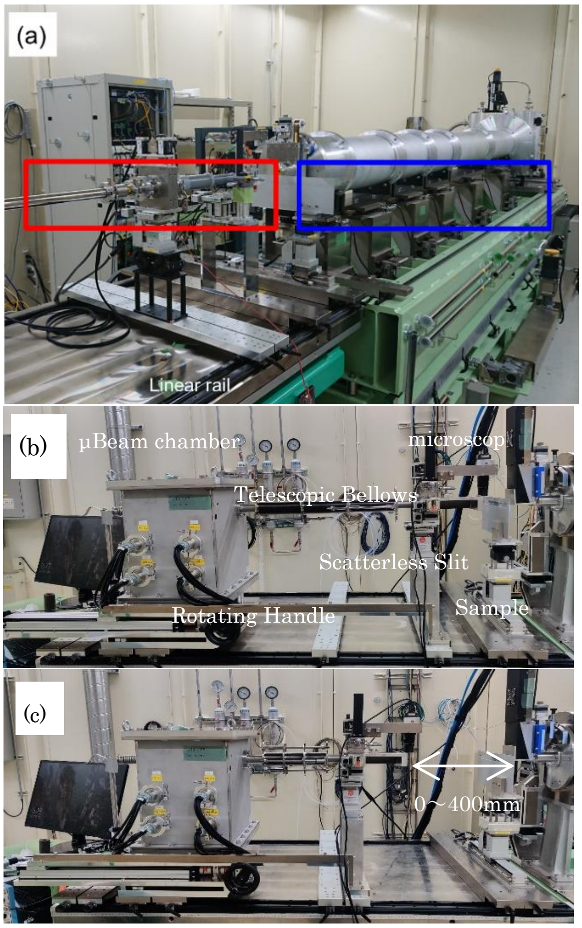

Fig. 1. (a) Layout of small-angle scattering measurement at camera distance of 4 m. (b) In the area shown in red, there is a guard slit (scatterless slit) for removing parasitic scattering, a microscope for observing the optical image of the sample, an automatic XZ stage for the sample, a detector for wide-angle scattering measurement, and a user-installed device. (c) Sample section with the autochanger spread wide open.

The user has to select the camera distance in the GUI shown in Fig. 2 and click the "Change Camera Distance" button. The process consists of the following seven steps: (1) The vacuum level is monitored and the leak valve size is changed in three steps. (2) After atmospheric pressure is reached, the motor moves the detector to the downstream limit position. (3) The vacuum pipe is disconnected by a compressed air. (4) The specified vacuum pipe is raised and lowered. (5) The vacuum pipe is connected by a compressed air. (6) The detector is connected to the vacuum pipe. (7) The vacuum pipe is pulled, and the camera distance can be fully and automatically changed in about 5 min.

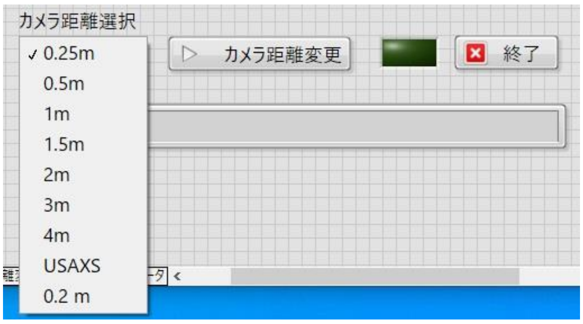

Fig. 2. GUI for changing the camera distance and the process that the program performs.

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