BL03XU
Advanced Softmaterial

1. Introduction

BL03XU is managed and operated by an industrial and academic joint organization, FSBL (Advanced Softmaterial Beamline), the advanced soft material beamline consortium, and is dedicated to the "production" use in soft matter development. The main methods performed at BL03XU are small-angle X-ray scattering (SAXS), wide-angle X-ray scattering (WAXS), ultrasmall-angle X-ray scattering (USAXS), microbeam SAXS/WAXS, grazing-incident SAXS/WAXS (GI-SAXS/WAXS), and X-ray photon correlation spectroscopy (XPCS). We have started development that facilitates the increased use of high-speed time-resolved measurements and XPCS.

2. Utilization situation

Figure 1 shows the percentages of methods used in FY2022, where SAXS/WAXS, microbeam SAXS/WAXS, and USAXS account for approximately 70%, while XPCS, SAXS-CT, GIWAXS, and other methods make up ~10%. Additionally, approximately 5% of the beamtime is allocated for joint research proposals in FSBL. The BL study required for beamline tuning and layout changes accounted for just under 15%, which was almost the same as that in previous years.

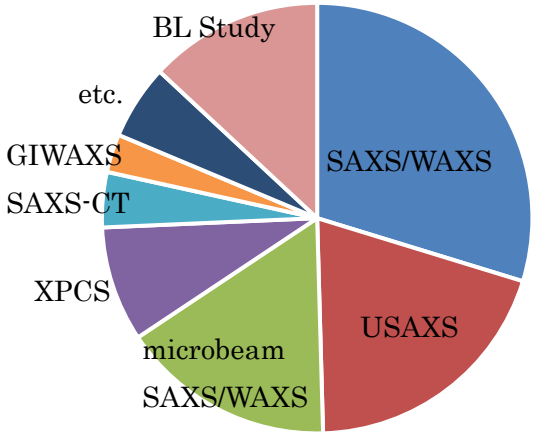

Fig. 1. Ratio of measurement methods used in FY2022.

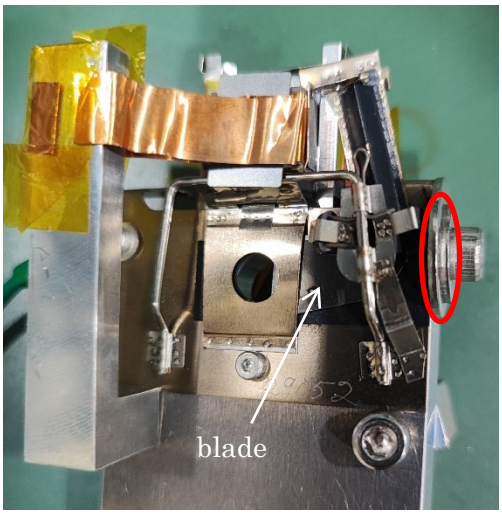

Fig. 2. Picture of mechanical part of the X-ray shutter removed from the vacuum chamber

3. Issue of high-speed X-ray shutter

For soft materials, sample damage caused by X-rays is recognized as a serious problem. In order to reduce X-ray damage to the sample, the proper use of an X-ray shutter is highly effective. BL03XU has used XRS6 (Vincent Associates) inside a vacuum chamber as the X-ray shutter for repetitive open/close operation at around 10 Hz. In recent years, the numbers of time-resolved measurements at 10 Hz and XPCS measurements have increased.

As a result, the open/close frequency has increased to the order of 10^4 in one day, which has caused mechanical trouble of the shutter. Figure 2 shows the mechanical part of the X-ray shutter. The area marked with a red circle was damaged.

As a new approach, we are considering the introduction of a rotary-drive shutter, which is a similar type to that used for SACLA. In this case, stable operation is expected even with the high-frequency use of the shutter. The design work is in progress.

4. Protection of the window and X-ray detector

In small-angle X-ray scattering measurements, a vacuum pipe is installed between the sample and the detector to prevent decrease the scattering intensity from the sample. To cover high-q measurements, a large-diameter X-ray window is required at the downstream position of the vacuum pipe. BL03XU uses a carbon-fiber resin film as the window material that has high transmission for X-rays. The film could be accidentally damaged when the pressure of the vacuum pipe is changed, which can cause further damage to the light-shielding film of the Pilatus detector placed near the window. To avoid such damage to the film, we carefully used adhesive (epoxy) to glue the film to the flange. In addition, we decided to attach a 3-mm-thick aluminum plate between the film and the detector to protect the detector even when the film is damaged. An automated control system for the plate position is being designed.

Masunaga Hiroyasu