BL40B2
Structural Biology II

1. Introduction

BL40B2 is a beamline where small-angle X-ray scattering (SAXS) is available for soft materials such as proteins, synthetic polymers, and lipids. Structural information is obtained in the Q-range from 0.016 nm^{-1} to 27 nm^{-1} at the magnitude of the scattering vector when a wavelength of 0.1 nm is used. To achieve such conditions, the vacuum path length for the SAXS detector must be varied between 250 and 6000 mm. On the other hand, to access a wide Q-range at once or easily, in the BL, simultaneous SAXS and wide-angle X-ray scattering (WAXS) measurements or a switching measurement system between SAXS and WAXS became available [1]. To enhance usability, we are developing a new vacuum chamber for WAXS measurements.

2. Development of vacuum chamber for WAXS

Figure 1 shows the layout of the new vacuum chamber. The size was 60 cm in diameter and 50 cm in width. The chamber made of aluminum was connected to the SAXS-vacuum path. A turbo-molecular pump had to be used to reach a vacuum pressure to prevent discharge in the detector. Since the detector (Eiger2 S 500K L-RW (Dectris Ltd., Switzerland)) was mounted on a four-axis motorized stage (X, Y, Z, θ), the position and angle of the detector were quickly arranged in the vacuum chamber as shown in Fig. 2.

Figure 2(a) shows that the situation where the detector can detect a WAXS range. It is also indicated that the detector should be moved from storage to between the sample and the SAXS detector. Figure 2(b) shows that the back-side SAXS detector detects a SAXS range when the WAXS detector moved outward away from a direct X-ray beam. It takes 8.6 s to switch between Figs. 2(a) and 2(b). Figure 2(c) shows that the detector

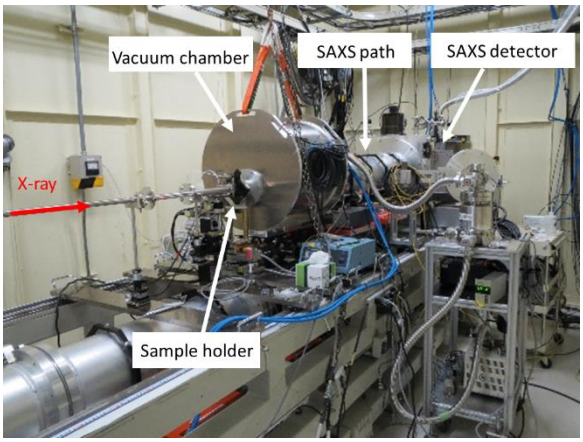

Fig. 1. Layout of new vacuum chamber at BL40B2.

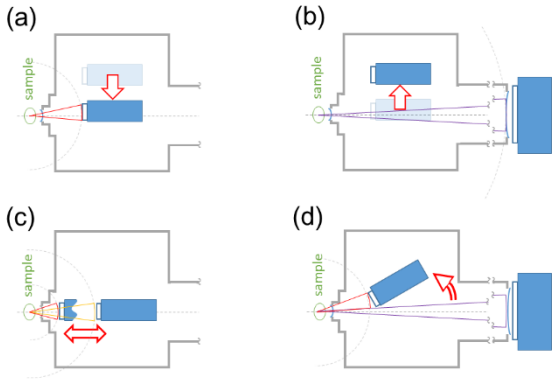

Fig. 2. Schematic illustration of detector arrangement in vacuum chamber (see text for details). The aluminum wall and the polymer window are drawn with a gray line and a blue line, respectively. Blue squares are the detectors.

can easily detect the optimized WAXS Q-range with varying camera length. Figure 2(d) shows that the simultaneous WAXS and SAXS measurements are achieved using two detectors, when the WAXS detector is tilted.

Key advantages are as follows. (a) The switching time obtained using the vacuum chamber is reduced by less than one-third of the previous switching time (30 s) [1]. (b) The variable range in the camera length of 85 mm is useful for obtaining the optimal WAXS pattern. (c) The simultaneous SAXS and WAXS measurements allow for hierarchical time-resolved experiments. We expect that the users will use this equipment not only efficiently but also conveniently in various experimental situations.

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Reference:

[1] Ohta, N. and Sekiguchi, H. (2020). *SPring-8/SACLA Annual Report FY2020*, 75.