BL16XU
SUNBEAM ID

1. Introduction

BL16XU is known as SUNBEAM ID, and together with its sister beamline BL16B2, it was designed to develop various industrial materials. It utilizes the high-brightness beam at the large-scale synchrotron radiation facility in SPring-8, and is operated by the SUNBEAM Consortium, which is a private organization comprised of 13 companies* (12 firms and 1 electric power group). BL16XU and BL16B2 began operations in September 1999, and the beamline use contract was renewed in April 2018.

X-rays emitted from an undulator are monochromatized, shaped, and converged in an optics hutch. The experimental hutch contains four experimental devices. Figure 1 and Table 1 schematically depict and outline the characteristics of BL16XU, respectively.

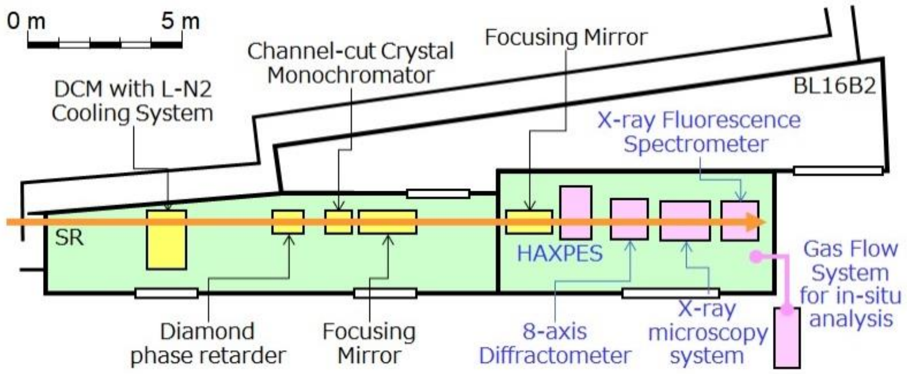

Fig. 1. Outline of BL16XU.

Table 1. Characteristics of BL16XU.

Light Source	In-vacuum X-ray undulator λ = 40 mm, N = 112
Energy range	4.5–40 keV
Energy resolution ($\Delta E/E$)	~ 10^{-4}
Photon intensity, beam size	~ 10^{12} photons/s , < 1 mm × 1 mm ~ 10^{10} photons/s , < 500 nm × 500 nm
Beam position stability	± 0.1 mm horizontal ± 0.8 mm vertical (5.0–30 keV)
Experimental facilities	HAXPES, XRD, XRF, micro-beam (Microscopy), gas-flow system (corrosive or toxic gas are possible)

* Kawasaki Heavy Industry, Kobe Steel, Sumitomo Electric Industries, Sony, Electric power group (Kansai Electric Power and Central Research Institute of Electric Power Industry), Toshiba, Toyota Central R&D Labs., Nichia, Nissan Motor, Panasonic, Hitachi, Fujitsu Laboratories, and Mitsubishi Electric Corp.

2. Utilization

Figure 2 shows the utilization of BL16XU in the past decade. The vertical axis shows the proportions for users, excluding the tune/study of the beamline itself. The upper graphic depicts the utilization by field. The application fields are mainly semiconductors, batteries, and materials. In recent years, battery-related research, which is typified by lithium-ion batteries, has increased. Additionally, semiconductors such as SiC and GaN are actively investigated.

The lower graph shows utilization by equipment (technology). Utilization of the HAXPES equipment, which was installed in 2014 and is mainly employed in semiconductor applications, is increasing. Additionally, studies on bonded dissimilar material structures are being conducted.

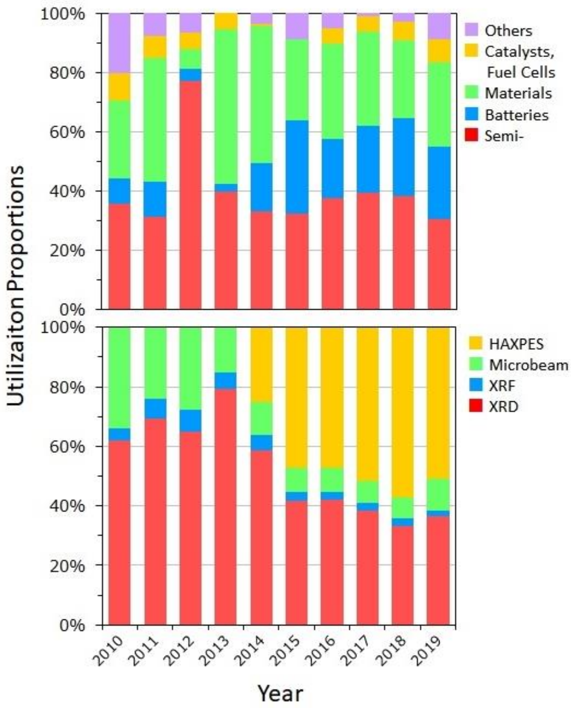

Fig. 2. Relative utilization times of BL16XU in the past decade.

3. Topics in FY2019

Below research and upgrades conducted in FY2019 are described.

3-1. X-ray diffraction

Pixel (two-dimensional) X-ray detector PILATUS 300K CdTe was installed for use of high-energy X-rays. Additionally, a rotating spiral slit system was installed to improve the precision of the gauge volume position using a two-dimensional (2D) detector. Together, the detector and the spiral slit system (Fig. 3) yield spatial resolutions of 0.7 mm along the incident beam and 0.08 mm in the orthogonal direction.

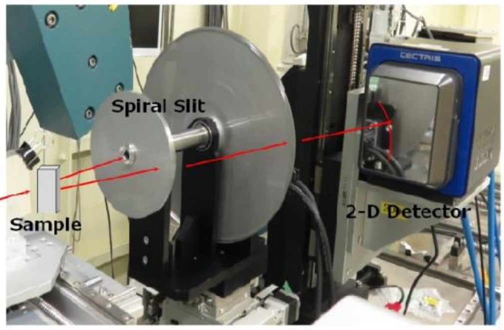

Fig. 3. Experimental apparatus for diffraction measurements.

Currently, a confocal XRD, which can selectively collect diffraction line intensities from tissues in deep areas of the sample, is under development. Figure 4 shows the diffraction pattern of the transmission arrangement of the laminated sample. In the transmission arrangement using the 2D detector of the sample in which Al and resin were laminated, each Al plate had three diffraction lines, but when using a spiral slit, an arbitrary focal position was obtained.

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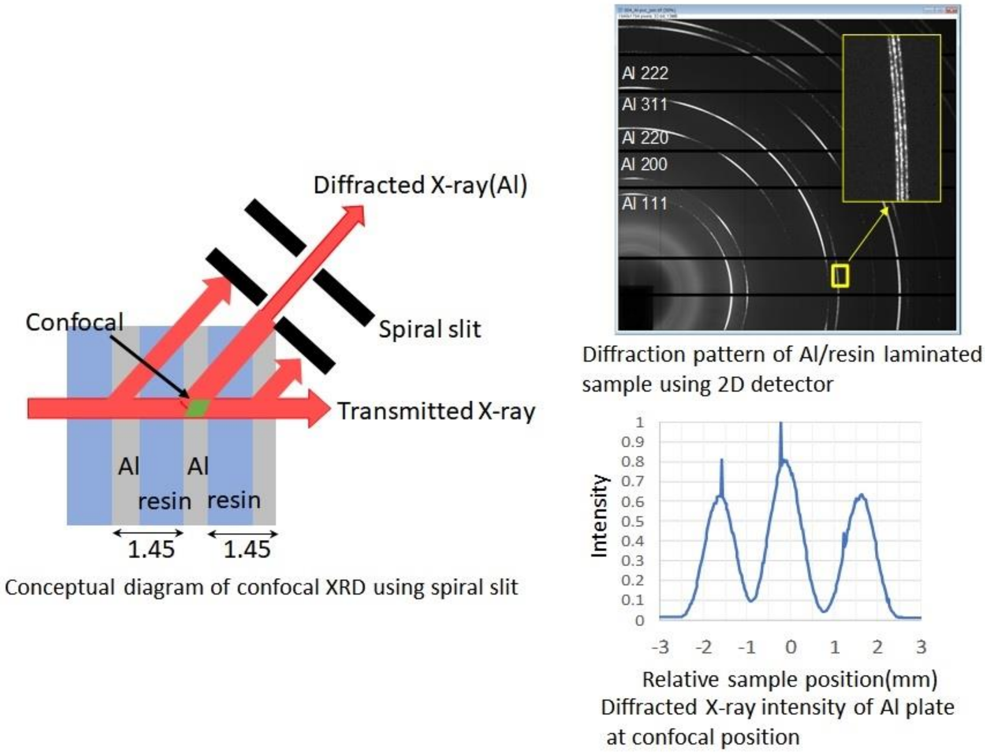

Fig. 4. Example of a spiral slit test using laminated sample (Al/resin).