TOYOTA Beamline BL33XU

TOYOTA beamline **BL33XU** has been designed and constructed especially for the observation of chemical reaction dynamically through XAFS technique. It will be very useful for research on catalysts, secondary batteries and fuel cells, which are very important technological targets for a sustainable future. The first X-ray beam was introduced in the optics hutch of BL33XU on April 3, 2009. In May, we finished the installation of optical components. The expected performance was confirmed before the long summer shutdown period. Since October, we have been using this XAFS beamline as an analytical tool, and at the same time, developing a super quick-XAFS system simultaneously.

BL33XU is a 120-m-long beamline, which has an experimental station outside of the storage ring building (Fig. 1). The light source is the SPring-8 standard in-vacuum undulator, especially equipped with a tapering mechanism, which broadens the undulator spectrum for XAFS measurement and is used for the first time at SPring-8. The SPring-8 standard components are used at the front-end. Two 1-m-long total-reflection mirrors are placed in the optics hutch in the parallel setting. By using these mirrors, the X-ray beam is deflected in the horizontal direction and extracted parallel to the incident beam. The glancing angle is fixed at 1.5 mrad, reflecting X-rays less than 45 keV. The second mirror is equipped with a bending mechanism that can focus the beam horizontally. The X-ray beam is transported through a vacuum duct toward the experimental hutches outside the storage ring building. As a monochromator, we adopted a new type called compact monochromator with a channel-cut Si single crystal driven by a servo motor. We use tandemly arranged two compact monochromators alternatively. Si 111 reflection covers the energy range between 4.0 and 28.2 keV, and Si 220 reflection covers the energy range between 6.5 and 46.0 keV. The compact monochromators are cooled by circulating liquid nitrogen. Although the beam position changes slightly during energy scan, this enables us to scan energy very quickly. The tapered undulator and this monochromator allow us to obtain a XAFS spectrum very quickly. Figure 2 shows our result of obtained with the super quick-XAFS system. So far, we can obtain one XAFS spectrum at 25 msec. After the monochromator, a pair of 700-mm-long total-reflection mirrors is installed in order to reduce higher order X-rays and focus vertically. X-ray beam is then introduced in the 2nd experimental hutch where the XAFS experiment is performed.

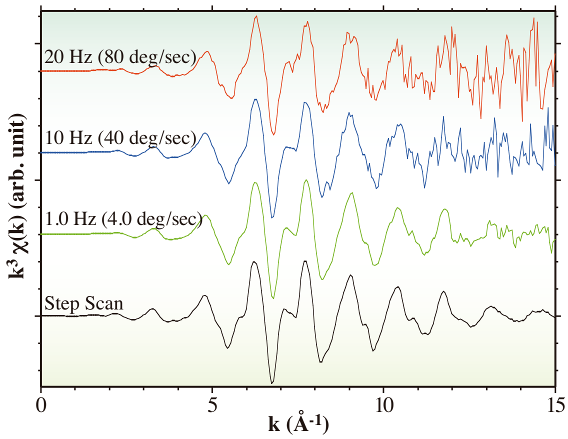

Fig. 2. Super quick-XAFS spectra.

In the 2nd experimental hutch we have a high speed gas reaction analysis system, which consists of: (i) three independent gas supply lines, (ii) a high speed gas switching and mixing apparatus, and (iii) a mass spectrometer with a sampling rate of 50 msec. For this system, a gas cylinder cabinet is embedded in the wall of the experimental station.

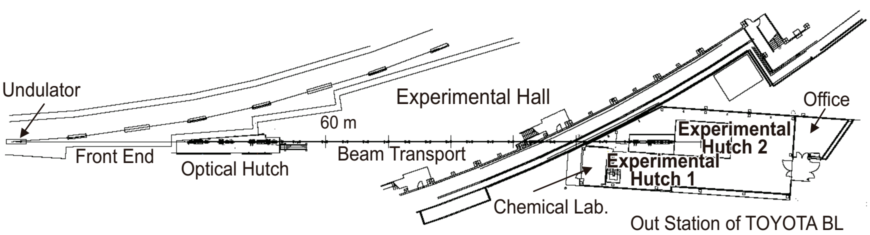

Fig. 1. TOYOTA beamline BL33XU.

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