5-1. Public Beamlines

BL01B1
XAFS

1. Introduction

BL01B1 is a public beamline dedicated to X-ray absorption fine structure (XAFS) measurements using X-rays over a wide energy range between 3.8 keV and 113 keV. It is used for various applications in materials science and chemistry. In FY2020, the BL01B1 beamline and its experimental station operated stably for user research. The latest beamline information is available on the website at https://bl01b1.spring8.or.jp/, including the performance characteristics of the XAFS spectrometer and other equipment as well as the appropriate user manuals. This report describes the improvements at BL01B1 in FY2020.

2. Control system for the deflection and elevation stages

In the optical hutch of BL01B1, the main X-ray optical elements consist of the first collimating mirror, double-crystal monochromator and second focusing mirror in the vertical direction. (Fig. 1). The position of the optical element downstream of the first collimating mirror is adjusted using the deflection stage and the elevation stage to the X-ray beam reflected by the first collimating mirror. In recent years, the motion of the control system for these stages has become unstable because of deterioration by long-time use. It had been used for more than 20 years, and manufacturer maintenance had expired. Therefore, the control system for these stages was updated.

One of the improvements is the update of the safety system. The control system allows both the manual and remote modes of operations. So far, in the manual operation, the operation procedure was set at each speed level. However, in the new system, the operation procedure has been unified to prevent erroneous operation due to the complicated procedures. Furthermore, the remote operation mode can be selected by sending control commands from the control PC in addition to the manual operation of the selection switch on the operation panel.

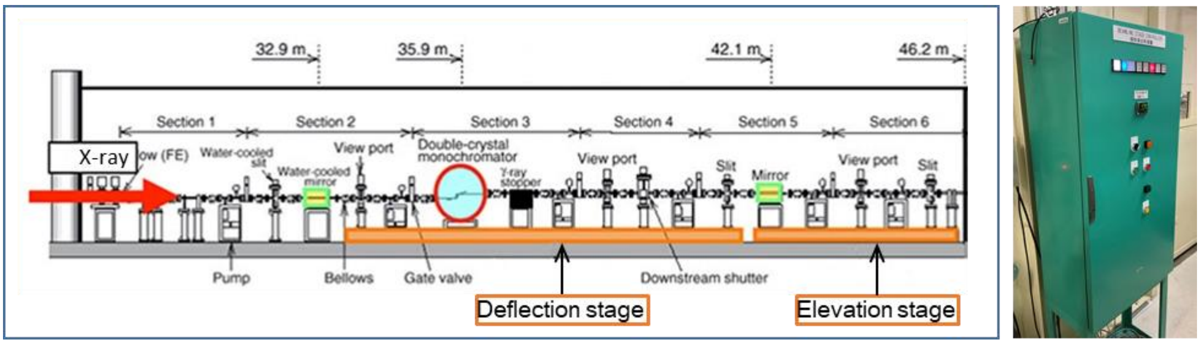

Fig 1. Schematic view of BL01B1 transport channel and the control panel for the deflection and elevation stages.

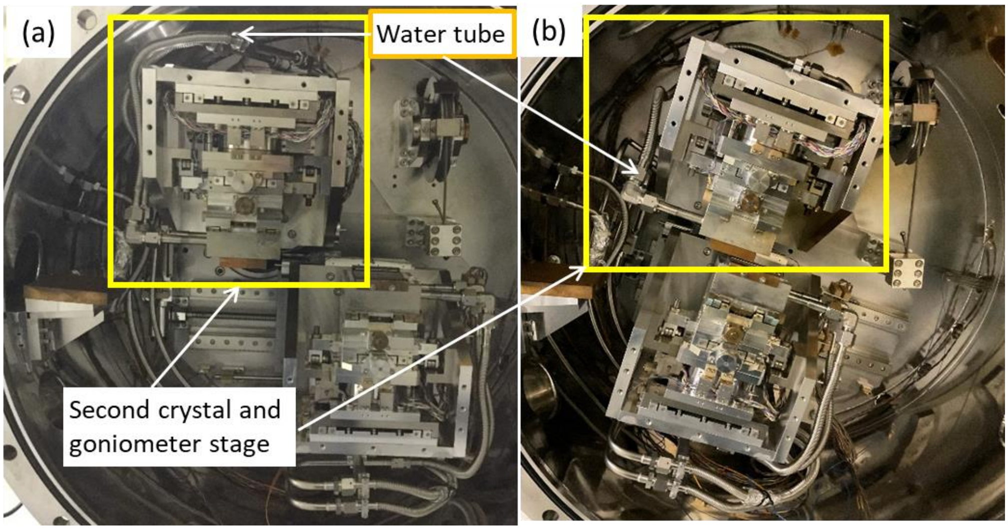

Fig 2. Interior of the double-crystal monochromator (a) before and (b) after remodeling the water plumbing system.

In the remote control mode, the RS232c and digital I/O interfaces were completely abolished, and the TCP/IP socket communication was adopted as the main interface to improve the complicated control architecture. In addition, the position control can be performed with high accuracy in a short time by increasing the number of speed levels from two (high, low) to three (high, middle, and low).

3. Improvement of monochromator

An adjustable inclined double-crystal monochromator has been adopted to cover a wide energy range of 3.8 to 113 keV. In this monochromator, the net plane of crystals can be switched among Si(111), Si(311) and Si(511) to cover the wide energy region.

However, the water tube for cooling and the goniometer stage for the second crystal are densely packed in a narrow area, so there was a risk of collision during the switching operation. Therefore, previously, when we used the Si(511) crystal, the crystal switch had been accompanied by the temporal modification of the water plumbing system, which was performed by breaking the vacuum of the chamber. In order to prevent interference among these components, the layout of the water plumbing system has been modified. As a result, the water plumbing system was radically remodeled, as shown in Fig. 2. Consequently, the net plane of each crystal can be switched smoothly without breaking the vacuum of the chamber.

4. Improvement of the encoder on θ-axis of monochromator

In QXAFS measurement, the high-speed signal converter with the encoder for the θ-axis (energy scan axis) of the monochromator is one of the important devices. The signal converter was replaced from IK 220 to EIB741 manufactured by HEIDENHAIN. In addition, because the EIB741 does not support the encoder signal of the current type, the encoder was changed from a current signal type to a voltage signal type. Consequently, the expansion of the energy range per scan was enabled by increasing the memory of the measured value.

Kazuo Kato and Toshiaki Ina
Spectroscopy and Imaging Division, Center for Synchrotron Radiation Research, JASRI