BL04B1
High Temperature and High Pressure Research

1. Introduction

BL04B1 is designed for high-temperature and high-pressure experiments using a large-volume press, and is mainly used in earth and planetary sciences and for the synthesis of new materials. BL04B1 operates as a bending magnet beamline and offers the capability to conduct energy-dispersive X-ray diffraction measurements and X-ray radiography observations using white X-rays. The X-rays emitted from the bending magnet are directly introduced into the experimental hutch. White X-rays with a wide energy range of up to 145 keV are utilized in measurements. This beamline is also equipped with a compact Si(111) double-crystal monochromator, which makes it possible to perform angle-dispersive X-ray diffraction measurements and X-ray radiographic observations using monochromatic X-rays with the photon energy between 30 and 60 keV. These high-energy X-rays allow us to conduct X-ray observations for samples totally surrounded by materials such as high-pressure vessels.

This beamline has two experimental hutches in tandem. A large-volume press with a maximum load of 1500 tons is installed in each hutch. These large-volume presses make it possible to carry out high-pressure and high-temperature experiments. The SPEED-1500 Kawai-type high-pressure press with DIA-type guide blocks is installed in the upstream hutch, while the SPEED-Mk.II Kawai-type high-pressure press with D-DIA-type and D-111-type guide blocks is installed in the downstream hutch. SPEED-Mk.II has differential rams (D-RAM) inside, which move independently of the main ram, and we can conduct deformation experiments under high-pressure and high-temperature conditions. By utilizing the large-volume presses with high-energy X-rays, we can routinely carry out *in situ* observations of materials under high-pressure and high-temperature conditions of up to 100 GPa and 2500 K in the beamline.

2. Updating the oil pressure system of the SPEED- 1500 press

Since the onset of the COVID-19 pandemic, the significance of remote experiments has grown. Over the past several years, we have been actively developing the infrastructure for conducting remote experiments. In FY2021, the oil pressure control system for SPEED-Mk.II was modified to allow remote experiments (see FY2021 Annual Report). In FY2022, an update was carried out on the oil pressure system of SPEED-1500. The previous oil pressure system for SPEED-1500, which could only be operated manually, under analog control, and as a stand-alone system, had been in service at SPring-8 for approximately 25 years since its inception in 1997. This was replaced with a user interface and pump unit similar to that of SPEED-Mk.II (Fig. 1). This update enables precise programmable pressurization and decompression control through remote control via a PC. In the future, we will develop the environment for automatic linkage with physical property measurements.

Fig. 1. Old oil system and new oil system installed at BL04B1.

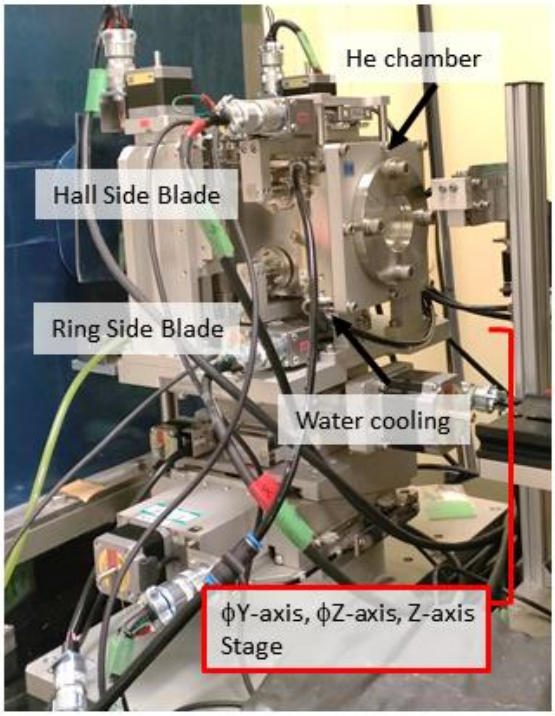

Fig. 2. Newly introduced He-purged incident slit.

3. Introduction of He-purged multiaxial water-cooled four-quadrant slit

BL04B1 is a white X-ray beamline and is exposed to very high X-ray flux, especially upstream of the experimental hutch, which causes irradiation damage to devices owing to scattered X-rays and ozonation of oxygen in the air, which oxidizes metals and damages rubber and plastics. Therefore, the incident slit of BL04B1 failed at a high frequency. For stable user operation, resistance to high-flux white X-rays is imperative and installation and operation must be easy. The newly introduced slit has a simple structure with indirect water cooling and a local chamber for He purging to prevent ozone effects (Fig. 2). Now, more than five months since the start of operation, the system has been operating without any trouble.

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