High Temperature Research (BL04B1)

The BL04B1 is a bending magnet beamline designed for high pressure and high temperature experiments. The beamline uses only an unfocused white beam over a range of 20 to 150 keV, which is suitable for energy-dispersive powder X-ray diffraction. This ideal white beam flux density at the sample is 1.0×10^{14} photons/sec/mrad^2 at 28.9 keV. The main experimental facilities are a large volume multi-anvil apparatus (SPEED-1500) and a high pressure vessel. The beamline has two experimental hutches, each of which is supported by two user subgroups, i.e. the high pressure mineral group and the high temperature group. One is dedicated to the large press (SPEED-1500), used for the high pressure mineral physics group, and the other is dedicated to the high pressure vessel, used for the high temperature group. These hutches have been built in tandem.

1. High Pressure Mineral Physics

The main high pressure facility SPEED-1500 is a double-stage type multi-anvil press with a 1,500 ton ram force. The outside first-stage is a DIA-type, and consists of six cubic type anvils in the [100] axis direction. The inside second-stage consists of eight cubic anvils, each of which has one corner truncated into a triangular face. The eight faces form an octahedral cavity. The eight second-stage anvils that are compressed by the six first-stage anvils compress an octahedral shaped pressure medium. In the present system, a 26 × 26 × 26 mm WC or a 14 × 14 × 14 mm sintered diamond anvil can be used as the second anvil. 25 GPa over 2,000˚C has been reached with the WC anvils with a maximum 1,500 ton ram load.

In order to carry out the energy-dispersive X-ray diffraction on the double stage system, holes are cut in the first-stage anvils to allow the X-ray beam to pass through. The incident white X-ray beam from the first-stage passes through the gaps between the second-stage anvils in a horizontal plane. The horizontal diffractometer covers a range of 2θ angles up to 15˚. The incident beam can be as low as 50 × 50 μm^2 and the diffracted X-rays are detected by Ge-SSD.

2. High Temperature

The tandem downstream hutch is designed for the structural study of high pressure and high temperature expanded fluid over a critical point. The main facility's high pressure vessel is equipped with a horizontal energy-dispersive X-ray diffractometer. The vessel has Be windows for the incident and scattered X-ray beam (2θ= 5, 10, 20, 33˚). High-purity He gas is used for the pressure medium, and the fluid sample contained in a single crystal sapphire cell is surrounded by the compressed He gas in the vessel. The pressure is measured by a Heise gauge at an accuracy of ±3 bar. The system is suitable for high pressure and high temperature X-ray diffraction measurement up to 2,000 kg/cm^2 and 1,650˚C.

Light Source	
Type	Bending magnet (BL04B1)
Energy range	0-150 keV (white)
Source size	σx=0.140 mm
	σy=0.024 mm
	σy'=0.920 μrad

X-rays at Sample	
Energy range	20-150 keV (white)
Beam size	0.05×0.05 - 10×10 mm^2
Beam divergence (V)	< 0.05 mrad
Beam divergence (H)	< 0.5 mrad
Beam stability	0.1 mm

Facilities in Experimental Station

(i) High pressure mineral physics station

- 1,500 ton large volume multi-anvil apparatus (SPEED-1500; 40 GPa, 2,000˚C)
- Horizontal goniometer, Pure Ge solid-state detector, Ion chamber

(ii) High temperature station

- High pressure gas vessel (He; 2,000 kg/cm^2, 1,650˚C)
- Horizontal goniometer, Pure Ge solid-state detector, Ion chamber