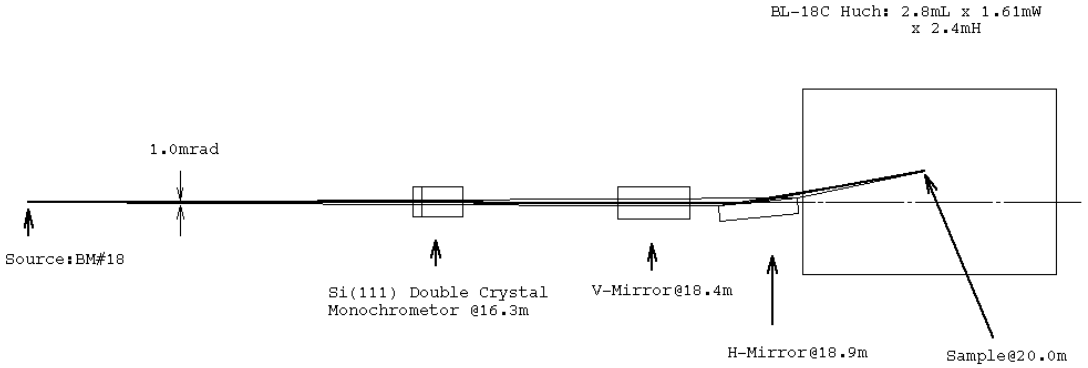
BL-18C Ultra High Pressure X-ray Powder diffraction Station

BL18C is a dedicated station for high pressure at high and/or low temperature experiment with a diamond anvil cell (DAC). DAC is the very compact high-pressure device, which generates pressure in a microscopic sample area by applying a load through the diamonds. Though the pressure is attained more than a 100GPa, the volume which realizes such ultra-high pressure is limited to the area where a diameter and thickness are slight of less than 40mm and 20mm respectively. Therefore, the high-pressure diffraction experiment became possible by using the synchrotron radiation and a high-performance detector such as an Imaging Plate, X-ray CCD and so on. The high-pressure powder diffraction experiment was carried out by using DAC-stage installed in 1997. It was composed by the following four parts; i.e. a pulse-motor drive DAC stage, an Imaging-Plate and X-ray CCD detector stage, a microscope stage and a base table.



SCHEMATIC VIEW OF THE BEAMLINE

Area of Research

High-pressure physics and Geophysical science.

Light Source

Type: Bending Magnet

Optics

Double-Crystal monochromator [Si(111)] + Two Pt-coated Fused Quartz Cylindrical Mirrors in K-B type arrangement.

Photons at sample

Energy: 6~25 keV
Energy Resolution: ~2 ($\Delta E/E \times 10^{-4}$)
Photon Flux: ~1×10^{11}/mm^2
Beam size: ~40mmV × ~85mmH (FWHM)

Facilities in Experimental Station

- Hutch dimensions: 1.61mW × 2.8mL × 2.4mH
- Photon intensity monitor system (Ion chamber and Photo-Diode).
- Collimators having f25, 40, 60, 80, 100μm sizes pinhole slit.

The IP (two kinds of vertical sizes of 250mm and 400mm with 200mm width) and an X-ray CCD detector C4880 (HAMAMATU Co, Japan; an effective diameter 160mm) are used to record diffraction patterns. Both detectors are assembled on a slide table with a 500mm-length stroke that is monitored with linear-encoder precisely.

A microscope optical device is installed to adjust the sample position for pressure measurement and X-ray diffraction. The pressure is determined by measuring the pressure-induced wavelength-shift of the ruby fluorescence. In order to excite the fluorescence an Ar laser is applied to the ruby minute particle (around one micron size) that it was put on the sample part of DAC. The microscope is mounted on a pulse motor drive stage, and through the optical fiber ruby fluorescence is led to the monochromator. Laser light is introduced with the optical fiber conversely in the microscope head from the generator. The CCD camera is fitted to the microscope head in order to monitor the sample.

A helium gas closed-cycle cryostat (LTS-22 RMC, USA) is provided for high-pressure experiment at Low temperature (>10K). Users should bring a miniature DAC with gas membrem (i.e. DXR-GM of DIACELL Products, UK or other DAC with similar size).

Devices in Preparation Laboratories

- Two microscopes (Leica, Swiss) are equipped for sample preparation with various types of DAC in a neighboring floor.
- A off-line pressure measurement optical system is also installed. The system consists of Ar laser, microscope and a monochromator system.

Other Information

Some instruction manuals (in Japanese) about high-pressure experiment are open for use in WWW (http://www.nimc.go.jp/dac/index-j.html) provided by Dr.Yamawaki of NIMC.
A diffraction pattern on an Imaging-Plat is read-out with BAS2000 system (Fuji-Film Co., Japan). The pattern (2-dimensional intensity data) can be transformed into a 1-dimensional intensity data by using PIP program (updated by Dr.Fujihisa of NIMC) with network computers connected to BAS2000 system (Ref.).

Reference

"Application of an imaging plate to high-pressure x-ray study with a diamond anvil cell, O.Shimomura et.al., Rev.Sci.Instrum., 63(1),1992, p967

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