Almax·easyLab
science under pressure

Application Note

Diacell® One20DAC: new diamond-anvil cell with very wide opening angle for x-ray and optical spectroscopy

Almax easyLab developed a new diamond-anvil cell with wide 120° opening. This cell enables its user to perform x-ray diffraction and X-ray and optical spectroscopic analysis of the sample with better accuracy thanks to a wider cover of the reciprocal space (x-Ray), Also Brillouin spectroscopy, can be performed concomitantly with x-ray diffraction.

Diacell® One20DAC characteristics

The expanded view of the One20DAC is presented in Figure 1. The cell is equipped with two right-handed and two left-handed pressure driving screw, with a stack of spring washers for more uniform pressure drive control, mounting pin for placing the DAC onto the goniometer head, and resistive heating option is soon to become available. Preliminary tests with diamond anvils of 500 micron culet size resulted in the maximum pressure of 23 GPa, close to that of other diamond-anvil cell of piston-cylinder type.

Figure 1. Expanded view of One20 DAC

In x-ray diffraction experiment, the crystal structure of the sample can be determined very precisely, especially if the sample is available in the single crystal form. Typical single-crystal diffraction pattern is shown in Figure 2. The structure of the crystal is determined by the analysis of diffraction peaks in reciprocal space and the amount of reciprocal space and, hence, the number of peaks available for analysis increases with the increase of the aperture of the diamond-anvil cell. One20 DAC opening is 120°, which is larger than the opening of any other cell available on the market. The cell has very compact design and its small thickness allows it to be easily mounted on any beamline or diffractometer. It has the diameter of 48 mm, same as Symmetric diamond-anvil cell, Plate DAC, and very close to BX-90 cell. This permits its use in commercially available gas loaders without the use of additional adapters.

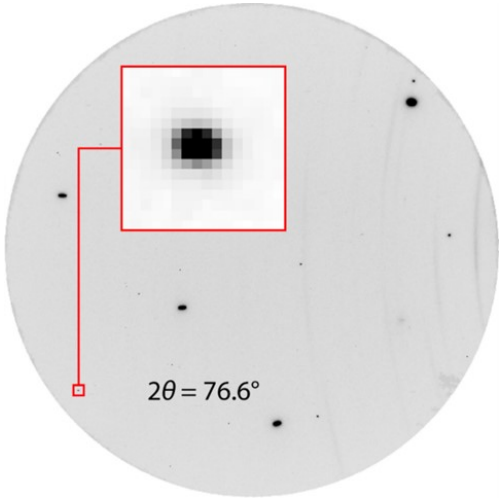

Figure 2. Typical single-crystal diffraction pattern of the sample with the high scattering angle peak selected

The cell has been tested at the 13-BM-C beamline at the Advanced Photon Source, Argonne National Laboratory (Figure 3). The cell will be very useful in studying the phase transitions in minerals and in organic solids, which often have very low crystal lattice structure symmetry and are, therefore, difficult to solve by using other diamond anvil cells.

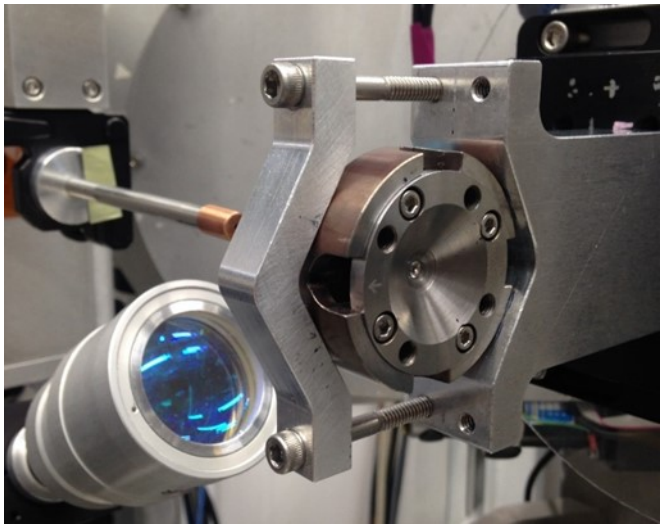

Figure 3. One20 DAC mounted on the goniometer of the 6-axis diffractometer at 13-BM-C beamline at the Advanced Photon Source, Argonne National Laboratory (Courtesy of James Walsh, Northwestern University).

Additionally, this cell can be used for optical spectroscopy, since its large numerical aperture (NA~0.87) allows more light to be collected. The large opening angle allows the Brillouin spectroscopy to be performed with better resolution. Common setup for this type of spectroscopy in DACs involves the scattering angle of 80° maximum, but with this new cell it can be increased to 120°, improving the resolution by about 30%.