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Single-crystal X-ray diffraction at extreme conditions

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Pressure is one of basic thermodynamic parameters, however its effect on chemical reactions, properties of materials and their structure remains relatively poorly understood, mainly due to the lack of experimental data. This deficiency of high-pressure information, compared to the vast amount of low- and high-temperature data, is due to the technical requirements of high-pressure experiments. They could be conducted only in strong vessels with thick walls, capable of withstanding high pressure, but obscuring access to the sample. The breakthrough in the high-pressure methods was the invention of the diamond-anvil cell, DAC [1]. Its design evolved in the second half of XXth century and finally made the DAC a powerful tool for *in situ* spectroscopic and diffraction investigations.

High pressure crystallography has become an efficient technique for crystal structure determinations and for monitoring phase transitions [2,3]. The diamond-anvil cell can be nowadays routinely applied in laboratories and dedicated beamlines of synchrotron and neutron facilities.

Synchrotrons provided new quality in X-ray diffraction and particularly in these experiments where very high intensity of the radiation is needed. It can be especially advantageous in high pressure crystallography, where the size of the sample is reverse to the attainable pressure.

The High Pressure Beamline ID09A at the European Synchrotron Radiation Facility is dedicated to the determination of structural properties of solids at high pressure using angle-dispersive-diffraction with diamond anvil cells. It offers monochromatic diffraction with large area detectors and provides beam seizes down to 10 x 10 μm at very high photon fluxes. High-pressure powder and single–crystal data can be collected from ambient pressure to approximately 200 GPa, as well as at low and high temperatures.

Several examples illustrating high pressure crystallographic studies and the research potential of ID09A are going to be presented.

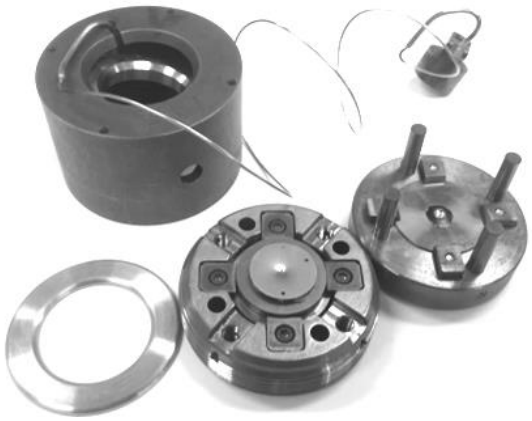

Figure 1. Membrane Diamond Anvil Cell (MDAC).

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