MSPD beamline for high pressure studies at Alba synchrotron

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Abstract

The Material Science Powder Diffraction (MSPD) beamline of Alba Synchrotron is dedicated to powder diffraction techniques. The superconducting wiggler generates a tunable photon beam between 8 and 50 keV. The beamline consists of two experimental stations positioned in series: a High Pressure station and a High Resolution/High Throughput powder diffraction station. The monochromatic beam is selected using a fixed exit double crystal monochromator and focused onto the sample using multilayers mirrors in the Kirkpatrick-Baez geometry. This is particularly suited for high pressure studies requiring a very small beam. The focal spot showed a 15x15 μm beam spot diameter at full width half-maximum in the range 20-50 keV.
The experimental enclosure of the HP station is dedicated to diamond anvil cells and consists of two towers of stacked rotation/tilt/translation stages supplied by Huber Diffracktionstechnik. The DAC is mounted on a tower composed, from bottom to top, of an XYZ stage/rotation stage/an XY stage (along the beam and vertical). In order to increase the powder averaging the DAC is rotated over a typical 5-30 range. Before the sample, a collimator and pin-hole aperture ranging from 30-200 μm serve to clean the tale of the beam. All the diffraction images are collected using transmission geometry on a Rayonix SX165 CCD detector. The range of the sample to detector distance is situated between 150 and 500 mm with the diffraction images scanned at 80 μm pixel resolution. The HP diffractometer can mount some attachments depending on needed experimental conditions. Most of the DACs, available for users, can be used at high temperature conditions with resistive heating system (_˜ 1000K) while helium cryocooling is employed for low temperatures (_˜ down to 15K).
The potential of the beamline will be illustrated by various results obtained on many scientific cases: study of phase transitions in orthovanadates, pressure effects in nanocrystalline oxides, thallium phase diagram at high pressure and high temperature, pressure induced helium trapping in molecular solids. Finally, futures developments of the beamline will be presented.

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