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Powder diffraction and X-Ray absorption spectroscopy in material science at the 3rd generation ALBA synchrotron source

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The ALBA-CELLS synchrotron located in the Barcelona area is actually the latest synchrotron source in Europe. Machine and beamline commissioning started at the end of 2010 and in mid 2011. First official users started in May 2012. The facility operates seven beamlines in soft X-ray energies (Resonant Absorption Scattering, Photoemission Spectroscopy and Microscopy, X-Ray Microscopy) and hard X-Ray energies (Non Crystalline Diffraction, Absorption and Emission Spectroscopy, Macromolecular Crystallography, Powder Diffraction). Two additional beamlines are under design/construction and proposals evaluation for 4 more beamlines is underway. Herewith, the two beamlines oriented to materials science essentially are presented: the Materials Science and Powder Diffraction (MSPD) beamline and the Core Level Absorption & Emission Spectroscopies (CLÆSS) beamline.

The MSPD beamline [1], with energy ranging from 8 to 50 keV consists of two experimental stations positioned in series: a High Pressure/Microdiffraction station and a high-angular resolution/high throughput powder diffraction station. The beam on the first station can be principally focused down to 15 x 15 microns using Kirckpatrick-Baetz geometry optics within a 0.25-0.60 Å wavelength range. Together with a Rayonix SX165 CCD detector and an appropriate stack of translation stages as sample/detector tower support, the station is designed to studies of limited size powder samples as is generally the case in High Pressure studies. Two standard types (Boehler and membrane-type cells) of diamond anvil cells (DACs) are parts of the standard sample environment equipment. The station is as well used for microdiffractions studies on e.g. cultural heritage samples for which exact localization of the beam impact on the sample is a perequisite. For this purpose, an online visualisation device has been in house designed.

The Powder Diffraction station consists in a 3-circles diffractometer delivered by HUBER. On the outer circle is mounted a 13-channels analyzer/YAP scintillator/PMT tube detector system allowing data collection at high angular resolution. Either 111 or 220 silicon Bragg reflections can be selected for the analyzers [2]. The middle circle is supporting 6 Si-based solid state detector modules (MYTHEN by DECTRIS) allowing simultaneous acquisition of powder patterns in a 40º 2Theta range at ms time resolution. Finally a heavy duty Eulerian Cradle can be optionally mounted on the inner circle. The wavelength range and beam size are 0.25-1.54 Å and max. 5 x 1.5 mm, respectively. Data can presently be collected in 80-1200 K temperature range, down to 5K later.

The CLÆSS beamline is dedicated to X-ray absorption (XANES, EXAFS) and X-ray emission spectroscopy. For absorption studies, a 200-500 micron beam, stable in position and size, is achieved over the energy range 2.4 - 68 keV. XANES and/or EXAFS spectra are presently collected in fluorescence mode, using standard commercial solid state detector, or in transmission mode, using the combination of ionization chambers and ALBA designed elctrometers. The so called CLEAR spectrometer is presently under commissioning and will allow X-Ray emission spectroscopy in the energy range 2-22 keV.

In the talk, I will give an overview of the two beamlines instrumentations and the most relevant steps of the commissioning. Typical examples of measurements performed on both beamlines, either by external users our in-house, will be presented. These examples cover as various filedd as cultural heritage, electrochemistry, catalysis, pharmaceutics, solid state physics and engineering studies.

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[1] F. Fauth, I. Peral, C. Popescu, M. Knapp, *Powder Diffraction* **V28** (2014) S360.
[2] I. Peral, J. McKinley, M. Knapp, S. Ferrer, *J. Synchrotron Rad.* **18** (2011) 1.