Combined XRR-GIXRF analysis at SOLEIL

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Combining Grazing Incidence X-Ray Fluorescence (GIXRF) and X-Ray Reflectometry (XRR) is gaining increasing interest for the accurate and precise characterization of innovative materials with structures at the nanometric scale. Different experimental setups dedicated to this techniques are already installed on synchrotron beamlines [1, 2, 3] or on laboratories, based on X-ray tube [4].

CASTOR is a new goniometer designed upon the model developed at Physikalisch-Technische Bundesanstalt (PTB), which is currently used on the METROLOGIE beamline of the SOLEIL Synchrotron [5]. CASTOR can be installed on each branch of the beamline: the XUV branch (30 eV – 1.9 keV) and the hard X-ray branch (3 – 38 keV) giving access to analyses over a large energy range.

The goniometer is composed of a vacuum chamber and a 7-axis manipulator (four translation and three rotation movements), making it a perfect tool for performing characterization methods. It is equipped with photodiodes to acquire the reflected (or transmitted) X-ray beam and silicon drift detector (SDD) to record the fluorescence spectra. The photodiodes were accurately calibrated using an electrical substitution cryogenic radiometer [6] and the SDD was calibrated using the SOLEX lab-source [7]. CASTOR is also equipped with a heating module, allowing to perform combined analysis of thin films under temperature change to provide deeper understanding of the structure and properties of these materials.

The GIXRF data are analyzed using the PyMCA software [8] and the XRR data are simulated with the PyXCEL software developed at CEA-LETI. Different examples will be presented, from single layer to test and optimize the experimental setup, to practical examples on innovative materials, such as transparent conducting oxides or chalcogenides [9, 10]

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