The X-ray Fluorescence Beamline at Elettra – Sincrotrone Trieste: New Characterization Opportunities for Nano-Structured Materials

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The X-ray Fluorescence beamline at Elettra–Sincrotrone Trieste [1] is conceived as a multi-purpose beamline designed to accommodate a variety of end-stations dedicated to e.g. X-ray Spectrometry, Total Reflection XRF (TXRF) or microscopy techniques. Located at a bending magnet source, its monochromator is presently covering the photon energy range 3.6 - 14 keV, with a resolving power of 1.4 \times 10^{14} (Si(111)). The source is re-imaged to a 250 X 50 \mu m beam size (hor X vert) in an exit slit, with an angular divergence of 0.15 mrad and a transmitted flux of about 5 \times 10^9 ph/s (5.5 keV, 2GeV). In the near future the excitation energy range of the beamline will be extended down to 2 keV, and multilayer coatings will increase the photon flux on the expense of a similarly increasing band width, however crucial for many applications.

The XRF beamline is presently hosting and operating in collaboration with the IAEA an Ultra-High-Vacuum Chamber (UHVC), based on a prototype [2] designed and built by Physikalisch-Technische Bundesanstalt (PTB) and Technische Universitaet Berlin (TUB). This UHVC includes a motorized 5-axis sample manipulator allowing 3 linear translations (x/y/z) and 2 rotational (theta/phi) degrees of freedom for the sample. An independent 2theta goniometer coupled with another linear axis allows performing X-ray reflectometry measurements. The aim is to use tunable synchrotron X-rays with ~200 \mu m beam size for various X-Ray Spectrometry techniques such as: TXRF, Grazing Incidence/Exit XRF (GIXRF/GE-XRF), X-Ray Reflectometry (XRR) or X-ray Absorption Spectroscopy (XAS).

A description of the beamline, analytical developments, and commissioning results will be presented to demonstrate the performance parameters for TXRF, GIXRF, XRR and combined XRF methods – XAS (X-ray Absorption Spectroscopy such as XANES and EXAFS) as well as the beam quality needed for advanced analysis.

Highlights will be put on experimental data obtained during pilot research experiments in the field of novel nanostructured layered materials and illustrate the manifold possibilities that the setup offers to analyze nanoscale samples.