X-ray fluorescence spectrometry beamline at Elettra Sincrotrone Trieste. Perspectives for trace element analysis in material science and environmental applications.

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A new, advanced X-ray spectrometry end-station [1] developed within a close collaboration between the Elettra Sincrotrone Trieste and the International Atomic Energy Agency has already completed three years of successful access provision to external users. The station is dedicated to X-ray fluorescence (XRF) and absorption spectrometry with its specific applications to trace element analysis. Operating in vacuum in the energy range 3.6 - 14 keV the facility allows researchers to carry out the XRF spectrometry under different alternative setup configurations, including either the conventional reflection (XRF 45/45) or the external total reflection (TXRF) geometry, but also allowing angle-dependent experiments, i.e. under grazing incidence/ exit angle (GI/GE-XRF), including also X-ray reflectometry (XRR). Being equipped with an advanced sample and detectors manipulation system the facility allows also for the complementary and synergistic application of different experimental strategies, e.g. a simultaneous GIXRF and XRR scan to investigate the structural features of nano-layered thin films or to perform X-ray absorption spectrometry (XANES) under TXRF geometry for trace elements speciation. In order to allow a user-friendly operation the instrumentation is controlled by the in-house developed software [2] comprising Tango control system and a LabVIEW modular graphical user interface.

Every year within more than 60% of beamtime the community of external users exploits the instrumentation mainly for the environmental studies, including mostly air or water pollutants in different areas of the world, e.g. Saudi Arabia [3] and Middle East [4], Asia Pacific region [5] and South America [6]. Other important application covers the issues related to medicine [7], life science [8] and thin-layered materials characterization [9]. By using well-characterized instrumentation, the facility is also used to deduce for some elements traceable datasets of X-ray fundamental parameters, thus evaluating the validity of various existing compilations and other theoretical databases [10-12].

The paper reports about the analytical performance of the instrumentation with a special emphasis towards the trace elements analysis. Exemplary applications on air pollutants characterization and the investigation of the in-depth distribution of deep-implanted heavy ion dopants into silicon wafers are discussed.

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