Reliable TXRF Quantification and Standardization Ventures

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During the last decades Total-reflection X-Ray Fluorescence Analysis, or TXRF, became one of the most powerful and cost competitive techniques for surface chemical and trace element analyses [1]. Tuning the angle of incidence across the critical angle of total external reflection, the composition of thin layered systems of low surface and interface roughness can be probed by means of the induced X-ray Standing Wave (XSW) field. The dimensions of the XSW field intensity are employed as a nanoscaled sensor in this Grazing-Incidence XRF, or GIXRF, technique [2]. TXRF and GIXRF have successfully demonstrated their analytical capabilities in various modern applications to bio- and nanotechnologies [3-8] involving minute sample amounts, surface functionalizations, nanoparticles and nanostructures. Even information about species mass depositions and the related chemical binding states [9,10] can be revealed when using tunable excitation radiation.

As a method of instrumental analysis TXRF became popular due to *chemical traceability* based calibration schemes using well-known one- or multielemental solutions a few µl of which being dried on flat substrate surfaces. Apart from the substrate surface morphology the absolute elemental mass depositions [11] determine the range in which linear interpolations of elemental mass depositions or concentrations are to be expected. International round Robin activities aiming at *standardization* and regulation updates reflect this challenge.

A complementary *physical traceability* chain can be established by using radiometrically calibrated XRF instrumentation [12] and knowledge on atomic fundamental parameters [13,14]. Here, a reference-free TXRF quantification approach, i.e. the quantification of elemental elemental mass depositions without the need for any reference materials or calibration samples, can be realized. Apart from known incident and emitted radiation intensities, modifications of the excitation intensity by the XSW field and the foot print dependent solid angle of detection are included in this quantification scheme. Since more than one decade the German National Metrology Institute PTB has a corresponding ISO 17025 compatible *quality management procedure* [15].

As most TXRF laboratory instruments rely on chemical traceability chains the appropriate preparation of both calibration specimens and samples to be analyzed is of decisive importance for a *reliable quantification*. The spatial distribution of the dried-in droplet depositions determines the linearity of the TXRF response behavior. Different preparation techniques for TXRF calibration samples are being evaluated within a German collaboration research project aiming at *ISO TC201 SC10 related standardization*.

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