Achieving nano-scale characterization with X-Ray Fluorescence Analysis

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Abstract.
X-Ray Fluorescence Analysis (XRF) is an established technique for qualitative and quantitative elemental analysis in a wide variety of application fields. The evolution of synchrotron radiation sources and advances in X-ray optics has allowed the achievement of collimated X-ray beams with dimensions in the nanometre range and the feasibility of nano-XRF scanning microscopy.
Nanometre sensitivity below a flat and smooth surface can be reached irradiating the surface with a parallel beam at grazing incidence. In fact, the total external reflection of X-rays can be exploited to limit the penetration of the beam in the sample and have high sensitivity for the topmost atomic layers. Increasing the angle, the information depth is also increased and information about depth gradients can be obtained. The technique typically called Grazing Incidence X-ray Fluorescence Analysis (GI-XRF) can be used for the study of thin layer films and contamination or dopant depth profiling.
The principle of microscopic reversibility suggests that the same nanometric depth sensitivity can be achieved by collecting the fluorescence emitted at grazing angles, phenomenon exploited by Grazing Exit X-ray Fluorescence (GE-XRF).
Combination of nano-XRF and GE-XRF could offer the possibility of nano-volume resolution without having to produce extremely thin lamellae.
The above mentioned techniques will be critically presented with application examples.