TXRF/GIRXF high precision laboratory setup with high flux monochromatic sources

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XRAYlab of ISPC-CNR in Catania has developed an instrument for x-ray fluorescence experiments near and below total reflection conditions, to enhance the signal form the surface layers (all the way down to few nanometers in thickness) while suppressing the contribution from the bulk of the sample. By changing the angle of incidence around the critical angle (grazing incidence conditions), not only the signal from the surface can be isolated but also the depth profile of coatings can be directly probed, making this method particularly suited for the study of thin surface layers. Since both the critical angle for total reflection and the penetration depth at a given angle of incidence are dependent upon the incident energy, high precision TXRF and GIRXF is traditionally implemented within synchrotrons (where highly monochromatic X-ray beams with little to no divergence are available), while table-top instruments are limited by both the directionality and polychromaticity of the incident beams. Thanks to the recent integration of highly monochromatizing optics into compact X-ray tubes for laboratory applications, such compromises are no longer necessary. In our set up, highly monochromatic beams can be obtained from the Cu Ka and the Ag Ka emissions of two such compact tubes, allowing the study of a wide range of chemical elements. The set-up has been used to determine the depth profile of a well characterized sample consisting in a Si substrate with a Ni surface deposition [1] and investigations of SiC substrates with homogeneous and inhomogeneous surface coatings as well as low dose surface implantation of Ti and V have been performed with the goal of optimizing the instrument for industrial applications. This work is conducted as a collaboration between academic and industrial partners, within the European framework MADEin4.

[1] Philipp Hönicke, Ulrich Waldschläger, Thomas Wiesner, Markus Krämer and Burkhard Beckhoff, 2020, Spectrochimica Acta Part B: Atomic Spectroscopy 174, 106009.

PREFERENCE*: ORAL