# DEPTH-RESOLVED SPECIATION OF BURIED NANOLAYERS

Beatrix Pollakowski, Burkhard Beckhoff
Physikalisch-Technische Bundesanstalt, Abbestr. 2-12, 10587 Berlin, Germany

Probing non-destructively buried nanolayers, photon-in photon-out spectroscopy provides an approach to study properties of materials beyond the information depth restrictions of conventional methods. Grazing Incidence X-Ray Fluorescence (GIXRF) in combination with Near Edge X-ray Absorption Fine Structure (NEXAFS) investigations enable depth-resolving analysis of thin layer stacks with respect to both the elemental composition and speciation. The strength of the X-ray Standing Waves (XSW) field strongly affects the mean penetration depth of the incident beam and can consequently tune the effective fluorescence information depth from a few to several hundreds of nanometers.

The sample system investigated in the present work consists of several 10 nm titanium nanolayers oxidized to different extents and buried below a preserving 5 nm carbon layer. The respective GIXRF-NEXAFS investigations were performed in the PTB laboratory at the electron storage ring BESSY II employing monochromatized undulator radiation and calibrated instrumentation [1, 2]. The results confirm the speciation potential when appropriate angular corrections [3], based upon parallel XSW simulations, ensure a constant mean penetration depth. The XSW calculations are based on an own software recently developed for the soft X-ray range and optical constants experimentally derived in that energy range in order to further improve the simulation. The measured Ti $L_{3,2}$ absorption spectra exhibit different bonds and oxidation levels, e.g. TiO, $Ti_2O_3$ and $TiO_2$, providing information comparable to that from other methods suited for near-surface layers. The full potential of this method is expected for double layer systems consisting of a titanium oxide ($TiO_2$ or $Ti_2O_3$) and the corresponding metallic layer.

References:

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[2] B. Beckhoff et al., Anal. Chem. **79**, 7873 (2007)
[3] B. Pollakowski et al., Phys. Rev. B **77**, 235408 (2008)