

Influence of experimental conditions on EUV / X-ray fluorescence yields investigated with the WDSX-300

V. Stoytschew⁽¹⁾, J. Probst⁽²⁾, C. Braig⁽¹⁾, T. Krist⁽²⁾ and C. Seifert⁽¹⁾

stoytschew@iap-adlershof.de

(1) Institute for Applied Photonics (IAP) e.V., Rudower Chaussee 29/31, 12489 Berlin, Germany

(2) NOB Nano Optics Berlin GmbH, Krumme Strasse 64, 10627 Berlin, Germany

The WDSX-300 spectrometer, developed at the Institute for Applied Photonics (IAP) in cooperation with Nano Optics Berlin (NOB), has been designed for wavelength dispersive X-ray fluorescence analysis with a scanning electron microscope (SEM-WDX) in the EUV and soft X-ray range. With the currently installed setup, an energy range from 30 eV to 400 eV can be covered, including $K\alpha$ fluorescence lines of elements like Lithium [1] or Boron. While working in the EUV range, experimental conditions are important: the sample damage from the X-ray excitation and the short propagation range of the X-ray fluorescence in the sample must be considered. Accordingly, the influence of the incidence angle, dose and kinetic energy of the electron beam on X-ray fluorescence (intensity and line shape) has been investigated.

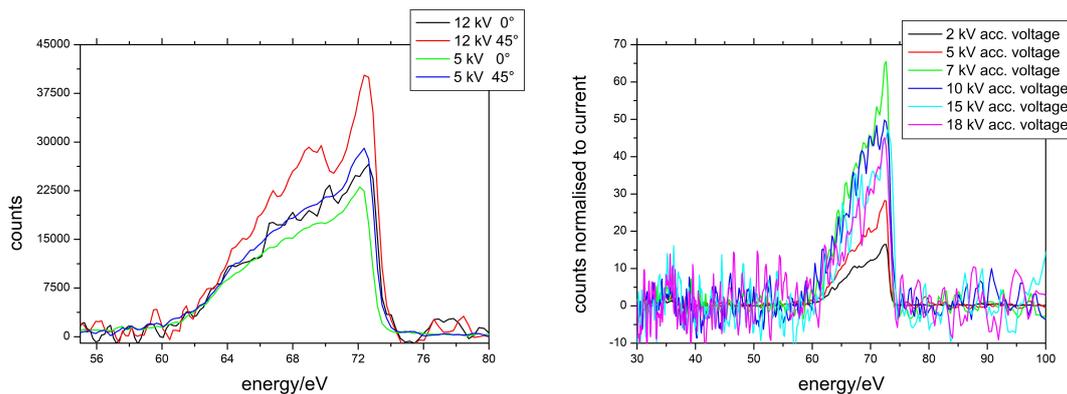


Figure 1: Influence of electron acceleration voltage and incidence angle on the X-ray fluorescence yield for Aluminium

X-ray fluorescence is produced through excitation by an electron beam in a JEOL 6400 SEM (beam focus size 4 μm – 20 μm , current \sim 200 nA). The emitted X-rays are then analysed in the WDSX-300 [1]: three hybrid reflection zone plates (h-RZPs) focus X-rays from the sample to straight lines on a CCD camera (greateyes GE 2048 512 BI UV1, 2048 x 515 pixels at 13.5 μm). High sensitivity in the extreme ultraviolet (EUV) / soft X-ray range is achieved by a wide sagittal acceptance, high diffraction efficiency and the focussing effect of the RZPs, while the spherically curved substrate [2-3] (radius 380 cm) provides the necessary spectral range. The compact layout of the WDSX-300 (309 \times 156 \times 165 mm³) makes it suitable for tabletop spectrometers, laboratory setups and an add-on to beamlines at large-scale facilities.

[1] K. Hassebi, N. Rividi, M. Fialin, A. Verlaquet, G. Godard, J. Probst, H. Löchel, T. Krist, C. Braig, C. Seifert, R. Benbalagh, R. Vacheresse, V. Ilakovac, K. Le Guen, and P. Jonnard, 2024, X-ray spectrometry **54**(2), 76-85.

[2] J. Probst, C. Braig, and A. Erko, 2020, Appl. Sci. **10**(20), 7210.

[3] C. Braig, J. Probst, E. Langlotz, I. Rahneberg, M. Kühnel, A. Erko, T. Krist, and C. Seifert, 2019, Proc. SPIE **11109**, 111090U.