SCANNING X-RAY MICROFLUORESCENCE FOR THE ANALYSIS OF VERY THIN OVERLAYERS

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Abstract

We used back-foil scanning X-ray microfluorescence (SXRF) and we examined the sensitivity of the technique for the analysis of very thin overlayers, where electron probe X-ray microanalysis (EPMA) reaches its detection limits. The lateral resolution of back-foil SXRF is also calculated for all the systems used. Both experimental results and Monte-Carlo calculations are used in this respect. Back-foil SXRF used in optimized experimental conditions, is found to be more sensitive than EPMA, especially in the case of very thin overlayers. The lateral resolution of back-foil SXRF is of the order of some micrometers. This is much better than the lateral resolution in conventional XRF and of the same order of magnitude as in EPMA.

Experimental Setup

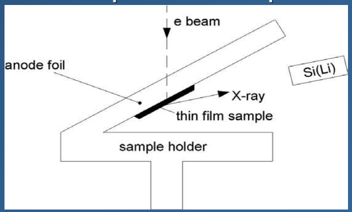

Figure 1a: Experimental setup used for back-foil XRF.

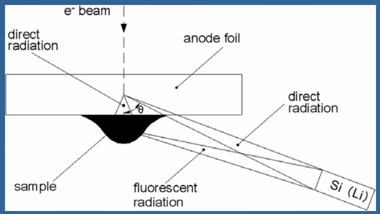

Figure 1b: Illustration of the trajectories of primary and fluorescence X-rays in back-foil XRF. The background is reduced by absorption of the continuous radiation, created by the electron beam, within the anode.

EPMA

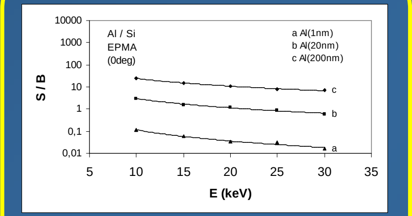

Figure 2a: Experimental values (EPMA) of the (S / B) ratio for Al/Si system and 0° angle of incidence.

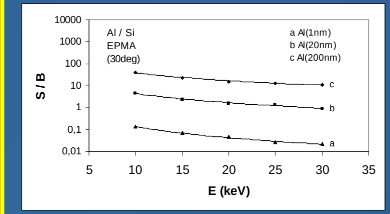

Figure 2b: Experimental values (EPMA) of the (S / B) ratio for Al/Si system and 30° angle of incidence.

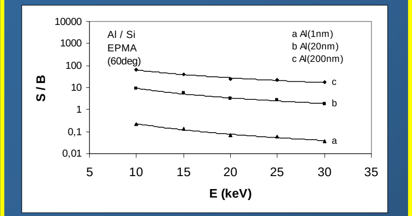

Figure 2c: Experimental values (EPMA) of the (S / B) ratio for Al/Si system and 60° angle of incidence.

SXRF

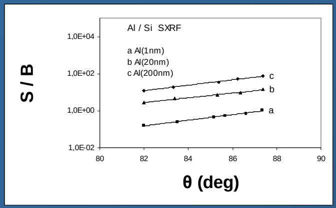

Figure 3: Experimental values of the S/B ratio in the case of back-foil XRF for Al/Si system and different film thicknesses as a function of the detection angle θ.

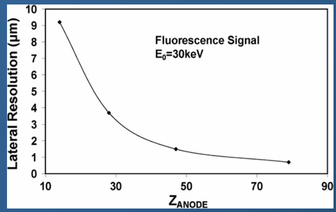

Figure 4: The lateral resolutions of the technique for various systems, as a function of the atomic number of the anode (Monte-Carlo calculations). The primary beam energy is 30 keV and the films thickness is 200 nm.

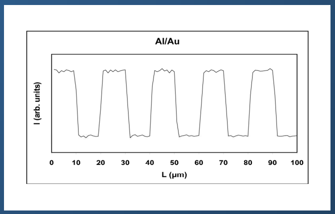

Figure 5: Line scan X-ray signal in the case of back-foil SXRF for Al/Au system. There is a pattern consists of 10μm Al lines and 10μm spaces on the backside of Au anode. The thickness of Al lines is 200nm.

Conclusion

Back-foil scanning XRF and EPMA are both applied to the analysis of very thin films. The sensitivity of back-foil XRF is better than that of EPMA in the case of very small film thicknesses (up to a few tens of nm) for any SXRF system. The lateral resolution of back-foil XRF is of the order of some micrometers. This is much better than the lateral resolution in conventional XRF and of the same order of magnitude as in EPMA. The obtained experimental results are verified by Monte-Carlo calculations.

Acknowledgements

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References

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