INVESTIGATION OF THE ELEMENT DISTRIBUTION IN TXRF SAMPLES USING SR µXRF

C. Horntrich[1,2], S. Smolek[2], A. Maderitsch[2], P. Kregsamer[2], R. Simon[3], A. Nutsch[4], M. Knoerr[5] and C. Streli[2]

[1]Recipient of a DOC-fFORTE –fellowship of the Austrian Academy of Sciences
[2]Atominstitut, Vienna University of Technology, 1020 Wien, Austria
[3]Forschungszentrum Karlsruhe, Institut für Synchrotronstrahlung, Hermann-von-Helmholtz-Platz 1, 76344 Eggenstein-Leopoldshafen, Germany
[4]Fraunhofer Institute for Integrated Systems and Device Technology, 91058 Erlangen, Germany
[5]Fraunhofer Institute for Integrated Systems and Device Technology (ZKLM), 90443 Nürnberg, Germany

Due to its outstanding properties Total Reflection X-ray Fluorescence Analysis (TXRF) is widely used in semiconductor industry for the analysis of silicon wafer surfaces. The presence of metal contamination on the wafer surface is a serious limiting factor to process yields for the production of integrated circuits. One of the major problems for standardization of TXRF for wafer surface analysis is the large statistical uncertainty of quantification.
In general TXRF is known to allow linear calibration typically using an internal standard for quantification. For small sample amounts (low ng region) the thin film approximation is valid neglecting absorption effects of the exciting and the detected radiation. For high total amounts of samples, deviations from the linear relation between fluorescence intensity and sample amount have been observed (saturation effect). This could be caused by the sample itself because real TXRF samples don't match the ideal TXRF sample which would be a thin, flat, homogeneous circle. Inhomogeneities and different sample shapes can lead to differences of the emitted fluorescence intensities and therefore high statistical errors.

The topic of the presented work is an investigation of the elemental distribution inside a TXRF sample to determine if this distribution is homogeneous. Both single element (Ni) and multi element (V, Mn, Ni, Ge) samples have been prepared. A SR µXRF setup has been installed at the Fluo beamline at ANKA. High sensitive elemental mapping combined with high lateral resolution using a SR µXRF technique lead to the result that for both single element and multi element samples the elemental distribution inside the samples is homogenous. A comparison of the SR µXRF image sets with microscope images shows a high correlation of sample shape. Additionally the SR µXRF and microscope images were compared to measurements done with a Laserprofilometer. Furthermore the µXRF results of the single element Ni samples were compared to TXRF measurements which were done with an Atomika 8030W waferanalyzer. Therefore a summation of the individual µXRF intensities was made. It could be shown that for both the TXRF and the µXRF measurements the relation between fluorescence intensity and sample amount is linear up to 150ng Ni.