Surface Chemical Analysis
Technical Work Area 2

Project A47

Evaluation of area selection fidelity in small-area XPS measurements

Background

◦ Evaluate a methodology for determining the selected area with small-area X-ray photoelectron spectroscopy (XPS) utilizing a specified artifact and measurement protocol

◦ Provide input into ISO/TC 201/SC 2 for the further development of ISO 18516 "Surface Chemical Analysis – Determination of lateral resolution and sharpness in beam-based methods with a range from nanometers to micrometers.

Background

Small-area XPS is increasingly used for the evaluation of structures on surfaces but is missing a validated methodology for quality control. Operators may thus be unable to determine if they use an incorrect field-of-view (FoV), such as sampling too large of an area, or a measurement position with an offset from the center of the structure. In such instances, electrons from the structure as well as electrons from the substrate would reach the detector.

To address this problem a test material was developed presenting two types of structure sets: Cr squares and Cr circles with lateral dimensions ranging from 300 µm to 5 µm embedded into an Au-coated substrate. A metrological SEM was used to confirm artifact consistency.

This test material is suitable for most beam sizes used in XPS for analysis of surface structures as small as 5 µm.

Standardization Needs

Both a methodology and calibration artifacts are desired for improving and validating lateral resolution and area selection of XPS to an accuracy of a few micrometers.

This study will provide results for the revision of ISO 18516 in ISO 201/SC2.

Work Programme

◦ Participants will receive a protocol, test artifact, and a data reporting sheet

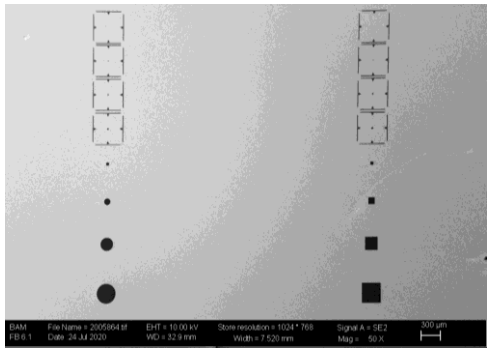
◦ Survey and high-resolution measurements with the instrument and software of the participants on each structure with at least three different beam sizes or apertures are demanded.

◦ Statistical analysis of the results from participants will be conducted as consistent with ISO/TS 5725.

Deliverables and Dissemination

Results will be centrally evaluated, with a plan for publication in a peer-reviewed journal. Results will also be used to inform the revision of ISO 18516 ("Surface Chemical Analysis – Determination of lateral resolution and sharpness in beam-based methods with a range from nanometres to micrometres).

Call for Participation



An overview SEM image of a test artifact

Participation

Participants need to be skilled operators with access to their own XPS and analysis software.

Funding

Participants fund their own involvement in the project.

Status

This project is identifying participants and readying the distribution of artifacts and the developed protocol.

The protocol and the test material were developed by BAM. The test material has been tested with two different XPS instruments and it was subjected to a quality control with metrological SEM. The uncertainties in length range from 0.05% to 11%.

References

▪ Baer, D. R. et al., *Surface and Interface Analysis* 29.11 (2000): 766-772. ▪ U. Scheithauer, *Surface and Interface Analysis* 40, no. 3–4 (2008): 706–709. ▪ Stockmann, Jörg M., et al, *Surface and Interface Analysis* 57 (2025): 131-136.

For more information:

Jörg M. Stockmann
Federal Institute for Materials Research and Testing (BAM)
joerg-manfred.stockmann@bam.de
Dr. Jörg Radnik
Federal Institute for Materials Research and Testing (BAM)
joerg.radnik@bam.de

TWA Chair and Vice-Chair:
Prof. Ian Gilmore
National Physical Laboratory, UK
ian.gilmore@npl.co.uk
Dr. Charles Clifford
National Physical Laboratory, UK
charles.clifford@npl.co.uk

www.vamas.org

July 2025