

PROJECT

SURFCHEM - TRACEABLE QUANTITATIVE SURFACE CHEMICAL ANALYSIS FOR INDUSTRIAL APPLICATIONS

URL

<http://www.emrp-surfchem.bam.de>

DURATION

2011 - 2014

PROJECT TYPE

EMRP funded project (European Metrology Research Programme, EMRP), Project No. IND15SurfChem

SCOPE

The project addresses chemical and topographical metrology at surfaces. The new methodologies of measurements at surfaces will be developed as good practice guides and new work item proposals for industrial ISO standards.

OBJECTIVES

The objectives of the Joint research project (JRP) are to provide measurement standards and methods with traceability wherever it is practicable to do so for quantitative surface chemical analysis for industrial applications. This includes:

- The provision of new certified reference materials (CRMs) with known and stable surface chemistries as well as with defined thickness and lateral structure for instrument development and calibration as well as verification of industry-relevant surface chemical measurements.
- The provision of new fast non-destructive methods of quantitative surface chemical analysis for industrial in-line quality control. In particular, this will include the development of advanced techniques for real time, in-situ measurement of catalyst structure and activity on a localised scale to underpin the development of more efficient, selective and cost-effective catalysts.
- The provision of metrological methods including development of new CRMs to improve the capability and traceability of technologies widely used in industry for surface analysis such as electron and fluorescence spectroscopy, X-ray reflectometry, electron probe microanalysis or ion mass spectrometry.

Two work packages deal with reference material and method development for industrial problems of inorganic and organic surface analysis. Analytical methods addressed are photoelectron and Auger electron spectroscopy, electron probe micro analysis, X-ray reflectometry and secondary ion mass spectrometry. One work package is dedicated to the development of traceable fast non-destructive methods of quantitative surface chemical analysis for industrial in-line quality control with a focus on contamination on

food and high end products. Methods applied in the related tasks are optical methods as IR and Raman, atmospheric pressure secondary ion mass spectroscopy as DESI and wettability testing methods (WCA) as well. New advanced optical and SPM based techniques used for real time, in-situ measurement of catalyst structure and activity on a localised scale are specifically addressed by another work package.

CO-ORDINATOR

Bundesanstalt für Materialforschung und -prüfung (BAM)

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PARTNERS

- Eidgenoessisches Justiz- und Polizeidepartement (EJPD), Switzerland
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- SP Sveriges Tekniska Forskningsinstitut AB, Sweden
- Chalmers University of Technology, Sweden
- ION-TOF GmbH, Germany
- Kratos Analytical Ltd, United Kingdom
- Scienion AG, Germany
- SPECS Surface Nano Analysis GmbH, Germany
- Focus GmbH, Germany

OUTCOME

The results are published as a summary and a final report with full details on the EURAMET website.

https://www.euramet.org/research-innovation/search-research-projects/details/?eurametCtcp_project_show%5Bproject%5D=1115&eurametCtcp_project%5Bback%5D=511&cHash=f971cb35d6ae35a16b55f5e16ca0da85

PUBLICATIONS

ARTICLE (JOURNAL)

- M. Hecht, T. Fischer, P. Dietrich, W. Kraus, A. B. Descalzo, W. E. S. Unger, K. Rurack, **Fluorinated Boron-Dipyrromethene (BODIPY) Dyes: Bright and Versatile Probes for Surface Analysis**, *ChemistryOpen*, 2013, 2, 25-38.
- M. P. Seah, S. J. Spencer, A. G. Shard, **Depth Resolution, Angle Dependence, and the Sputtering Yield of Irganox 1010 by Coronene Primary Ions**, *The Journal of Physical Chemistry B*, 2013, 117, 11885-11892.

- V.-D. Hodoroaba, M. Procop, V. Rackwitz, **Check and specification of the performance of EDS systems attached to the SEM by means of a new test material EDS-TM002 and an updated evaluation software package EDS spectrometer test - Version 3.4**, *Microscopy and microanalysis 2013*, 19 1256-1257. DOI: 10.1017/S1431927613008271.
- M. Giovannozzi, F. Pennechi, A. Saverino, C. Lobascio, A. M. Rossi, **Traceable measurement of specific organic species at industrially relevant surface by Infrared Spectroscopy**, *Special Issue in Surface and Interface Analysis 2014*, 46, 915-919, DOI: 10.1002/sia.5447.
- P. T. Z. Adibi, F. Mazzotta, T. J. Antosiewicz, M. Skoglundh, H. Grönbeck, C. Langhammer, **In situ Plasmonic Sensing of Platinum Model Catalyst Sintering on Different Oxide Supports in O₂ and NO₂ Atmosphere**, *ACS Catalysis 2015*, 5, 426-432 DOI: 10.1021/cs5015173
- M. Giovannozzi, F. Rolle, M. Sega, M.C. Abete, D. Marchis, A. M. Rossi, **Rapid and sensitive detection of melamine in milk with gold nanoparticles by surface enhanced Raman scattering**, *Food Chemistry 2014*, 159, 250-256, DOI: 10.1016/j.foodchem.2014.03.013.
- G. Shard, S. J. Spencer, S. A. Smith, R. Havelund, I. S. Gilmore, **The Matrix Effect in Organic Secondary Ion Mass Spectrometry**, *International Journal of Mass Spectrometry 2015*, 377, 599-609, DOI: 10.1016/j.ijms.2014.06.027
- V. D. Hodoroaba, M. Krumrey V. Rackwitz, **New Reference and Test Materials as well as Procedures for Checking the Performance of an Energy Dispersive X-Ray Spectrometer (EDS) at a Scanning Electron Microscope (SEM)**, *Analytical and Bioanalytical Chemistry 2015* 407 3045-3053, DOI: 10.1007/s00216-014-8242-5
- P. Sjövall, B. Agnarsson, L. Carlred, A. Gunnarsson, F. Höök, **Liposome binding for multiplexed biomolecule detection and imaging using ToF-SIMS**, *Surface and Interface Analysis, ECASIA special issue 2014*, 46., 707-711, DOI: 10.1002/sia.5494.
- L. Carlred, A. Gunnarsson, S. Solé Domènech, B. Johansson, V. Vukojevic, L. Terenius, A. Codita, B. Winblad, M. Schalling, F. Höök, P. Sjövall, **Simultaneous Mapping of Amyloid- β and Lipids in Brain Tissue using Antibody-coupled Liposomes and Time-of-Flight Secondary Ion Mass Spectrometry**, *The Journal of the American Chemical Society 2014*, 136., 9973-9981. DOI: 10.1021/ja5019145.
- M. Holzweber, A. G. Shard, H. Jungnickel, A. Luch and W. E. S. Unger, **Dual beam organic depth profiling using large argon cluster ion beams**, *Surface and Interface Analysis, ECASIA special issue 2014*, 46, 936-939. DOI: 10.1002/sia.5429.
- J. Wernecke, A. Shard, M. Krumrey, **Traceable Thickness Determination of Organic Nanolayers with X-Ray Reflectometry**, *Surface and Interface Analysis, ECASIA special issue 2014*, 46, 911-914. DOI: 10.1002/sia.5371.
- G. Shard, **Detection Limits in XPS for more than 6000 binary systems using Al and Mg K α X-rays**, *Surface and Interface Analysis, ECASIA special issue 2014*, 46, 9. DOI: 10.1002/sia.5406.
- P. Sjövall, B. Agnarsson, L. Carlred, A. Gunnarsson and F. Höök, **Liposome binding for multiplexed biomolecule detection and imaging using ToF-SIMS**, *Surface and Interface Analysis, ECASIA special issue 2014*, 46, 707-711 DOI: 10.1002/sia.5494.
- Fischer, T ; Dietrich, PM; Streeck, C; Ray, S; Nutsch, A; Shard, A; Beckhoff, B; Unger, WES; Rurack, K, **Quantification of variable functional-group densities of mixed-silane monolayers on surfaces via a dual-mode fluorescence and XPS label**, *Analytical Chemistry*, 2015, 87, 2685-2692, DOI:10.1021/ac5038501.
- Elzbieta Gurdak, Felicia M. Green, Paulina D. Rakowska, Martin P. Seah, Tara L. Salter, Ian S. Gilmore, **VAMAS interlaboratory study for desorption electrospray ionisation mass spectrometry (DESI MS) intensity repeatability and constancy**, *Analytical Chemistry*, 2014, 86, 9603-9611, DOI 10.1021/ac502075t.

- Andrew J. Wain, Andrew J. Pollard, and Christoph Richter, **High-Resolution Electro-chemical and Topographical Imaging Using Batch-Fabricated Cantilever Probes**, *Analytical Chemistry*, 2014, 86, 5143-5149, DOI 10.1021/ac500946v.
- Kumar, N; Stephanidis, B; Zenobi, R; Wain, AJ; Roy, D, **Nanoscale mapping of catalytic activity using tip-enhanced Raman spectroscopy**, *Nanoscale* 2015, 7, 7133-7137, DOI: 10.1039/C4NR07441F.

PROCEEDINGS

- T. Fischer, M. Hecht, P. Dietrich, W. E. S. Unger, K. Rurack, **Development of a dual XPS and Fluorescence Label for the Analysis of Surface Amino Groups**, *Proceedings 8. ThGOT Thementage Grenz- und Oberflächentechnik*, 2012, Leipzig, Germany.

TALK

- A. Shard, **Surface chemical analysis beyond the boundaries with cluster ions**, *NMAET (Nano-Molecular Analysis for Emerging Technologies) V*, 2012, Teddington, UK.
- E. M. Larsson, K. Wettergren, J. Millet, S. Gustafsson, M. Skoglundh, V. P. Zhdanov, C. Langhammer, **Operando Indirect Nanoplasmonic Spectroscopy of Catalyst Sintering and Deactivation**, *International Symposium on Surface Science: Towards Nano- Bio- and Green Innovation*, 2011.
- V.-D. Hodoroaba, **Silizium-Drift-Detektoren kontra ISO 15632:2002**, *Kolloquium 30 Jahre EDS-Analytik in Berlin*, 2012, Berlin, Germany.
- V.-D. Hodoroaba, V. Rackwitz, **Reference materials for the performance check and specification of energy dispersive X-ray spectrometers (EDS) in electron probe microanalysis (EPMA)**, *European Conference on X-Ray Spectrometry EXRS 2012*, 2012, Vienna, Austria.
- B. Tyler, R. Havelund, A. G. Shard, S. J. Spencer, S. Smith, M.P. Seah, I. S. Gilmore, **Advances in metrology for depth profiling of organics using cluster ion beams**, *8th European Workshop on Secondary Ion Mass Spectrometry – SIMS Europe 2012*, 2012, Münster, Germany.
- A.G. Shard, S. J. Spencer, S. Smith, I. S. Gilmore, R. Havelund, **New organic reference materials for cluster ion sputter depth profiling**, *AVS-59 International Symposium & Exhibition 2012*, Tampa, USA.
- A. M. Giovannozzi, A. Saverino, C. Lobascio, F. Pennecci, A.M. Rossi, **New methodology for traceable measurement of specific organic species at industrially surfaces by optical methods**, *ECASIA 13 (15th European Conference on Applications of Surface and Interface Analysis)*, 2013, Sardinia, Italy.
- A. Wain, **Imaging Size Effects on the Electrocatalytic Activity of Gold Nanoparticles Using Scanning Electrochemical Microscopy**, *Europacat (XIth European Congress on catalysis)*, 2013, Lyon, France.
- A. Shard, **Measuring Molecular Attachment to Nanoparticles**, *19th International Vacuum Congress IVC*, 2013, Paris, France.
- A. Wain, **Advances in Electrochemical Scanning Probe Microscopy for Mapping the Electro-activity of Nanostructured Surfaces**, *ECASIA 13 (15th European Conference on Applications of Surface and Interface Analysis)*, 2013, Sardinia, Italy.