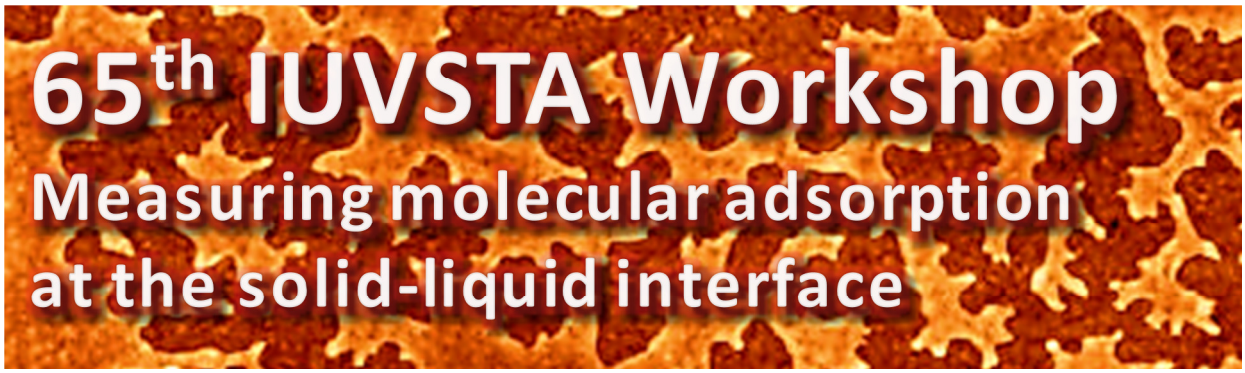

25th June, 2012

Final Report for the 65th IUVSTA Workshop: Measuring molecular adsorption at the solid-liquid interface.

Chair: Alex Shard, National Physical Laboratory, Teddington, UK
Co-chairs:
Anouk Galtayries, ChimieParisTech, France
Wolfgang Unger, Federal Institute for Materials Research and Testing, Germany
Santanu Ray, National Physical Laboratory, Teddington, UK

Dates: 14th - 18th May 2012

Location: Peckforton Castle, Cheshire, UK.

Website: http://www.iuvsta65.org/

IUVSTA divisions: Applied Surface Science and Biointerface.

Introduction

The 65th IUVSTA workshop on the measurement of molecular adsorbates at the solid-liquid interface was held in the UK on 14th - 18th May 2012. Processes which occur at the solid-liquid interface impact on some of the most important areas of science and technology. These include biomaterials, biotechnology, personal care, food production, catalysis, adhesion, corrosion and fouling. One of the most important processes is the adsorption of molecular solutes at the interface. However, experimental techniques which reveal the details of these processes provide limited information and, in many cases, do not provide information that may be interpreted in a reliable and quantitative manner. Within this field, many practitioners rely upon the use of vacuum-based methods to understand the nature of the interface before and after events have taken place within a liquid. The importance of this field has been recognised within IUVSTA with the inauguration of the Biointerfaces Division. This workshop represents the first IUVSTA workshop with a strong relevance to this new division and has been co-organised by members of the Biointerfaces and the Applied Surface Science Division.

The workshop focused on current and emerging techniques to measure the identity, amount and structure of adsorbates at solid-liquid interfaces. A wide range of methods are available which have varying levels of maturity and sophistication. The workshop was organised into coherent themes,

starting with the fundamental understanding of adsorption and attachment of molecules at interfaces and moving onto the various techniques, their capabilities and weaknesses and the relevance of these measurements. The workshop enabled a unique opportunity to bring together international experts from a wide range of backgrounds, institutions and countries to discuss these issues, share thoughts and ideas and to establish the most pressing issues which need to be addressed. A key area of current interest is the adsorption of molecular species at nanoparticle-liquid interfaces. This is important in the stability of nanoparticle suspensions, their utility in technological applications and their fate in the environment and living systems. Currently, there are a paucity of methods to understand processes. On Tuesday evening, the kick-off meeting for the European Metrology Research Programme project "BioSurf" was held at the same venue. The aims of this project are strongly aligned to the topic of the meeting and this provided excellent synergy. It is anticipated that some of the recommendations from the workshop can be completed as part of this European project.

Participants

The workshop brought together 43 scientists from 12 countries, with representatives from academia, national laboratories and industry. The full list of attendees is provided in Appendix 1. Two additional participants registered for the meeting, but were unable to attend due to unforeseen circumstances. Invited talks were provided by Michael Grunze, Sally McArthur, Buddy Ratner, David Castner, Heike Arnolds, Janos Vörös, Fredrik Höök, Matthew Wagner, Jennifer Shumaker-Parry and Mathias Schubert. Participants had a broad range of expertise including experts in surface analysis, surface engineering, biomaterials, diagnostic devices, industrial applications, simulation and theory and instrument development. The participants engaged wholeheartedly in open discussions enabling the workshop to identify areas where advances need to be made. In a feedback survey, the majority of participants rated the workshop as 'excellent', with the highest praise given to the venue, speakers, technical content and organisation.

Workshop Programme

There were 10 invited and 22 contributed talks, which were organised in 11 themed sessions, covering the fundamentals of molecular adsorption, methods by which adsorption could be controlled, the measurement of adsorbate amount, composition and structure and industrial perspectives and needs. Emphasis was placed upon methods which could be applied directly to the

solid-liquid interface and a significant fraction of the programme covered the important issue of adsorption on nanostructured and nanoparticle surfaces. The full programme is given in Appendix 2.

There was a strong focus on in-depth discussions on the themes and topics introduced by the speakers, sufficient time was allocated after each session to allow participants to debate the relevant issues. The contents of these discussions were collated and summarised on posters and considered further and refined in the two summary poster sessions. The collective opinions, outcomes and recommendations were finally discussed in the closing session leading to a consensus view of the most important areas in which require action. The remote location, shared evening meals and social events enabled and encouraged participants to interact and permitted an open and useful discussion to emerge.

Summary of Discussion

The discussions at the workshop were wide-ranging and covered the important issues relevant to the topic of the workshop. A guiding theme within the discussions was to consider not only all of the unanswered questions, but to consider actions that could be taken to address these. In some cases it was not possible to identify definitive actions but, in many cases, actions could be identified. The discussion points and recommendations are grouped below by action areas.

Fundamentals: Throughout the workshop, gaps in our current understanding of the behaviour of molecular adsorbates were highlighted and discussed. The effect of surface topography or curvature on molecular adsorption was of particular concern, both in terms of adsorption behaviour and also the influence on the measurement technique. This is an issue of primary importance in the study of nanoparticles in liquid media and for the analysis of medical materials, which often have significant topography and porosity. The electric potential of the substrate seems to have a profound impact on adsorbate behaviour and this is an area where further investigation is required. There was a strongly expressed need for predictive models of molecular adsorption and behaviour at solid-liquid interfaces and the development of this is hampered by the lack of a convenient summary of thermodynamic data. A particular problem is the selection of the most relevant adsorbates to study, for example, recent evidence suggests that vitronectin is significantly more important than fibronectin in cell adhesion yet the latter has been more widely investigated. One area of particular interest is the interaction between adsorbates in either competitive or co-operative adsorption, this is of particular technological relevance.

Recommendations: A concerted effort to measure and understand the influence of surface charge and curvature on molecular adsorption is required. Greater attention should be given to interactions between adsorbates in both single and mixed solutions. A programme of engagement with external communities to identify the most relevant systems should be undertaken.

Literature: There was a general consensus at the workshop that access to historical studies and data was difficult and presented a significant barrier for new researchers in the area. The main issues appear to be that the earliest works are hard to find using modern databases due to patchy coverage, recent studies are published in a wide range of journals and are of a variable quality.

Recommendations: A summary review or website should be established to enable access to literature, particularly the earlier and most reliable works. A comprehensive critical review of

measurement techniques should also be undertaken, with a useful commentary on the advantages and pitfalls of combining different techniques.

Standard methods and materials: The development of new and emerging methods is hampered by the lack of benchmarks which are both useful and easy to employ. Radiolabelling is widely considered to be the most acceptable benchmark method and has the advantage that it is accurate, if the correct procedures are used. However, the capabilities and expertise to perform such measurements are not widespread and difficult to compare to other methods on the same samples due to the issue of instrument contamination with radioactive material. There was clear agreement that the sensitivity and reproducibility of other methods, such as QCM and optical techniques, were good but that their accuracy was less certain and they had a narrower applicability. Additionally, concern was expressed that the practical implementation of the various techniques contributed to a lack of comparability. Equally important in this regard is the availability of materials or systems where adsorption behaviour is known, well understood and reproducible. Such standard materials or systems would be of major benefit to practitioners who are developing new methods or where instrument calibration is required.

Recommendations: Standard samples should be developed which are suitable for establishing the comparability of current methods, provide a clear understanding of the relationships between different methods and enable the development of new techniques. Guidance and standards should be provided for the implementation of the most common and industrially relevant techniques, such as QCM, SPR, ellipsometry and XPS. These should cover sample preparation, flow conditions, washing steps, drying steps if applicable, and data recording, interpretation and reporting. It was recognised that some of the techniques involve a model-based approach to data interpretation and recommendations for the most appropriate and simplest models which can be applied should be provided, as well as the manner in which uncertainty should be calculated and expressed. Procedures for labelled molecules are required to ensure differences in behaviour from unlabelled analogues are minimised and guidelines for control experiments in this context are required.

Molecular orientation: The measurement of molecular orientation and structure for complex adsorbates is in its infancy. Techniques such as SIMS, NEXAFS, CD, IR and SFG appear promising, but data interpretation is difficult and suitable samples to advance such studies are hard to find. For UHV-based techniques, such as SIMS, reliable methods to prevent restructuring of adsorbates need to be established. Other techniques rely upon the labelling of molecular adsorbates with detectable groups. A greater clarity on how to quantify molecular orientation is required and comparability between laboratories and techniques needs to be established.

Recommendations: Comparison between different methods and laboratories requires the generation of a suitable material system. Once this is established, it was proposed that an interlaboratory study on SFG should be undertaken.

Immobilisation methods: Methods for the attachment of molecules to surfaces require development. There is an increasing need to attach defined quantities of specific molecular adsorbates in specific orientations and to measure whether attachment has been carried out in a specific or non-specific manner. Many of the approaches used routinely appear to be of questionable reliability and there is a need for fresh methods which have greater specificity and reproducibility. It was felt that other communities, such as those working in affinity chromatography

may have useful experience which could be exploited. There were no recommendations on this point, except as noted below.

Future workshops: The large majority of participants felt that the workshop had been extremely valuable and recommended that a similar workshop be held in two or three years' time. There was a general consensus that a wider community should be engaged within the debate, including more representatives from the industrial, sensor and biological communities. It was recognised that the same topic could not be repeated as an IUVSTA workshop and that increasing the number of delegates would also not be appropriate under IUVSTA rules.

Recommendations: A similar workshop should be held in two to three years' time, mechanisms for funding and organising the workshop should be explored.

Conclusion

The workshop was an outstanding success: the participants viewed the event as highly beneficial, a number of new links were established and future collaborative work was proposed. The community engaged in an open and friendly manner to identify the most important and tractable areas which should be addressed in the near future. The venue, discussions and the personal links established at this event will remain in the participants' memories for a long time.

Acknowledgements

The workshop was primarily sponsored by IUVSTA (the International Union for Vacuum Science, Techniques and Applications). Without this generous support, the workshop would not have been possible. We are grateful for additional support from Biolin Scientific, LOT-Oriel, Kratos Analytical, UKSAF (UK Surface Analysis Forum), BVC (British Vacuum Council) and Asylum Research, which enabled the organisers to subsidise refreshments, excursions and reduce the day delegate rate. We are also grateful to NPL for Alex Shard's and Santanu Ray's time in organising the workshop.

Financial Statement

Here, it is certified that the financial support of €6000 provided by IUVSTA for the *65th IUVSTA Workshop: Measuring molecular adsorption at the solid-liquid interface*, was fully used to cover fixed costs, namely partial costs for 9 invited speakers.

Appendix 1 – Workshop Attendee List

Last Name	First Name	Affiliation	Country
Abel	Marie-Laure	University of Surrey	UK
Agnarsson	Björn	Chalmers University of Technology	Sweden
Alexander	Morgan	University of Nottingham	UK
Alvarez	Marcela	University of Limerick	Ireland
Ansalone	Patrizio	Istituto Nazionale di Ricerca Metrologica	Italy
Arnolds	Heike	University of Liverpool	UK
Barfoot	Richard	Unilever Research	UK
Barnes	Cara	University of Utah	USA
Booker	Adam	National Physical Laboratory	UK
Castner	David	University of Washington	USA
Ceccone	Giacomo	JRC Institute for Health and Consumer Protection	Italy
Cooper	Cindy	University of Utah	USA
Dellinger	Antoine	ChimieParisTech	France
Dietrich	Paul	Federal Institute Materials Research and Testing	Germany
Galtayries	Anouk	ChimieParisTech	France
Gandhi	Abbasi	University of Limerick	Ireland
Grunze	Michael	Heidelberg University	Germany
Gunning	Paul	Smith & Nephew	UK
Gurdak	Elzbieta	National Physical Laboratory	UK
Hardy	Nick	Biolin Scientific	UK
Höök	Fredrik	Chalmers University of Technology	Sweden
Ivashenko	Oleksii	University of Groningen	Netherlands
Krumrey	Michael	Physikalisch-Technische Bundesanstalt	Germany
Lamarre	Baptiste	National Physical Laboratory	UK
Lechuga	Laura	Res. Center on Nanoscience and Nanotechnology	Spain
Malzer	Wolfgang	Technische Universität Berlin	Germany
McArthur	Sally	Swinburne University	Australia
Müller	Matthias	Physikalisch-Technische Bundesanstalt	Germany
Noble	James	National Physical Laboratory	UK
Peremans	André	University of Namur	Belgium
Petrovykh	Dmitri	International Iberian Nanotechnology Laboratory	Portugal
Ratner	Buddy	University of Washington	USA
Ray	Santanu	National Physical Laboratory	UK
Schierack	Peter	Lausitz University of Applied Sciences	Germany
Schubert	Mathias	University of Nebraska-Lincoln	USA
Shard	Alex	National Physical Laboratory	UK
Shumaker-Parry	Jennifer	University of Utah	USA
Swann	Marcus	Biolin Scientific	UK
Sjövall	Peter	SP Technical Research Institute of Sweden	Sweden
Unger	Wolfgang	Federal Institute Materials Research and Testing	Germany
Vörös	Janos	ETH Zurich	Switzerland
Wagner	Matthew	Procter & Gamble	USA
Weigel	Wilfried	SCIENION AG	Germany

Appendix 2 – Workshop Programme

Monday 14 May

1:30 pm to 2:50 pm ***Fundamentals of Molecular Adsorption***

Michael Grunze
"Quantification of adsorption, adhesion and mechanical stability in biological environments: experiments and theory"
Patrizio Ansalone
"pH Dependent Conformational Distribution of a Weakly Charged Polyelectrolyte Chain onto Charged Spherical Surface"
Dmitri Petrovykh
"Quantitative Evaluation of Peptide Adsorption on Gold Surfaces"

2:50 pm to 3:20 pm	*Discussion*
3:20 pm to 3:40 pm	Coffee / Tea

3:40 pm to 5:00 pm ***Immobilisation Methods***

Sally McArthur
"Surface Immobilisation and Characterisation of Proteins in Microfludic Devices"
Wilfried Weigel
"The specifics of array-based biofunctionalization"
Baptiste Lamarre
"Directed bio-molecular immobilisation on surfaces for differential diagnostics"

5:00 pm to 5:30 pm	*Discussion*
6:30 pm	Drinks Reception and History Talk, Wine Cellar

Tuesday 15 May

8:30 am to 9:35 am ***Labelled Molecules***

Buddy Ratner
"Relevance and the Art of Protein Adsorption Measurement"
Elzbieta Gurdak
"Conjugation of fluorescent dyes changes the adsorption behaviour of proteins"

9:35 am to 10:20 am	*Discussion*
10:20 am to 10:40 am	Coffee / Tea

10:40 am to 12:00 pm ***Molecular Orientation and Structure***

David Castner
"Strategies for Structural Analysis of Surface Bound Peptides and Proteins"
Giacomo Ceccone
"Measuring Protein Structural and Stability Changes upon Protein-Nanoparticle Interactions"
Kwasi Kwakwa
"Measuring the 3-D orientation of fluorescent molecules embedded in synthetic lipid bilayers"

12:00 pm to 12:30 pm	*Discussion*
12:30 pm to 1:30 pm	Lunch

1:30 pm to 2:50 pm ***Emerging Methods I***

Heike Arnolds
"Advances in nonlinear optical spectroscopy of molecules at interfaces: Can anyone do it?"
Matthias Müller
"Investigation of the Adsorption of Self-assembled Monolayers on Germanium Surfaces by Near Edge X-ray Fine Structure Spectrometry"
Cara Barnes
"Enhanced Two Photon Processes for Molecule Localization on Plasmonic Nanocrescents"

2:50 pm to 3:20 pm	*Discussion*
3:20 pm to 3:40 pm	Coffee / Tea

3:40 pm to 5:00 pm	***Summary Poster Session***
3:40 pm onward (parallel with above)	***EMRP "BioSurf" Kick-Off Meeting***

Wednesday 16 May

8:30 am to 10:05 am ***Functional Surfaces***

Janos Vörös
"Ions, molecules, and cells at electrodes"
Morgan Alexander
"The Role of Albumin and Fibronectin in the Adhesion of Fibroblasts to Plasma Polymer Surfaces"
Oleksii Ivashenko
"A spectroelectrochemical study of the redox and photochemical functionality of the spiropyran-merocyanine molecular switch in solution and in self-assembled monolayers"
Abbasi Gandhi
"Selective protein absorption on electrically modified hydroxyapatite: probing with a kelvin force probe and confocal microscope"

10:05 am to 10:45 am	*Discussion*
10:45 pm to 11:15 pm	Coffee / Tea

11:15 am to 12:30 pm	***Contributed Poster Session***
12:30 pm to 1:30 pm	Lunch
1:30 pm to 4:30 pm	Excursion to Beeston Castle or Chester City
4:30 pm	Falconry Display at Peckforton Castle
6:30 pm	Pre-dinner drinks
7:30 pm	Banquet Dinner in Peckforton Great Hall

Thursday 17 May

8:30 am to 9:50 am ***Emerging Methods II***

Fredrik Höök
"Single molecule detection and equilibrium fluctuation analysis using fluorescent lipid vesicles as signal enhancement elements"

Peter Sjövall
Multiplexed biomolecule detection using liposome binding and mass spectrometry imaging"
Michael Krumrey
"Size Determination of Nanoparticles with Synchrotron Radiation-based SAXS"

9:50 am to 10:20 am	*Discussion*
10:20 am to 10:40 am	Coffee / Tea

10:40 am to 12:00 pm ***Industrial applications and needs***

Matthew Wagner
"Industrial Needs and Practical Considerations for the Measurement of Adsorption at Interfaces"
James Noble
"Characterization of Biomolecule coated nanoparticles for Diagnostic Tests"
Marie-Laure Abel
"The Utility of Adsorptions Isotherms in Adhesion Science"

12:00 am to 12:30 pm	*Discussion*
12:30 pm to 1:30 pm	Lunch

1:30 pm to 2:50 pm ***Optical Methods I***

Jennifer Shumaker-Parry
"Plasmonic Architectures for Challenges Related to Adsorption Measurements of Complex Samples and Small Molecules"
Laura Lechuga
"Surface tailoring of highly specific optical biosensors"
Björn Agnarsson
"Evanescent-wave excitation using a planar waveguide"

2:50 pm to 3:20 pm	*Discussion*
3:20 pm to 3:40 pm	Coffee / Tea

3:40 pm to 5:00 pm ***Optical Methods II***

Mathias Schubert
"New chemical, biochemical and biological sensing and separation principles based on highly ordered three-dimensional nanohybrid materials thin films"
Peter Schierack
"A Highly Versatile Microscope Imaging Technology Platform for the Multiplex Detection of Biomolecules"
André Peremans
"Far-field optical vibrational micro-spectroscopy with sub-diffraction resolution"

5:00 pm to 5:30 pm	*Discussion*
5:45 pm to 6:30 pm	***Summary Poster Session***

Friday 18 May

8:30 am to 9:45 am ***Quantitative Analysis***

Alex Shard
"XPS analysis of adsorbed proteins"
Anouk Galtayries
"Combining quantitative XPS and QCM techniques: elaboration of surface mechanisms in corrosion and protein adsorption"
Paul Dietrich
"How successful is surface chemical analysis in the characterization of (model) diagnostic devices exploiting probe-target interaction?"

9:45 am to 10:20 am	*Discussion*
10:20 am to 10:40 am	Coffee / Tea
10:40 am to 12:30 pm	***Summary and Final Discussion***
12:30 pm	Lunch and Meeting Close

65th IUVSTA Workshop
"Measuring molecular adsorption at the solid liquid interface"
14th to 18th May 2012 at Peckforton Castle, Cheshire, UK
Workshop Programme Schedule

Monday 14th May 2012

Time:	**1:30 pm to 3:20 pm**
Session Title (**MO1**):	**Fundamentals of Molecular Adsorption**
Invited Talk:	Prof. Michael Grunze, Heidelberg University, Germany "Probing the liquid/solid (bio) interface with neutrons and non–linear optical techniques"
Contributed talk (Each 15min): (Followed by Discussion)	Dr. Patrizio Ansalone, Istituto Nazionale di Ricerca Metrologica, Italy "pH Dependent Conformational Distribution of a Weakly Charged Polyelectrolyte Chain onto Charged Spherical Surface". Dr. Dmitri Petrovykh, International Iberian Nanotechnology Laboratory, Portugal "Quantitative Evaluation of Peptide Adsorption on Gold Surfaces".

Time:	**3:40 pm to 5:30 pm**
Session Title (**MO2**):	**Immobilisation Methods**
Invited Talk:	Professor Sally McArthur, Swinburne University of Technology, Australia "Surface Immobilisation and Characterisation of Proteins in Microfludic Devices".
Contributed Talk (Each 15min): (Followed by Discussion)	Dr. Wilfried Weigel, SCIENION AG, Berlin, Germany "The specifics of array-based biofunctionalization". Mr. Baptiste Lamarre, National Physical Laboratory, UK "Directed bio-molecular immobilisation on surfaces for differential diagnostics".

Tuesday 15th May 2012

Time:	**8:30 am to 10:20 am**
Session Title (**TU1**):	**Labelled Molecules**
Invited Talk:	Professor Buddy D. Ratner, University of Washington, USA "Relevance and the Art of Protein Adsorption Measurement".
Contributed Talk (Each 15min): (Followed by Discussion)	Dr. Elzbieta Gurdak, National Physical Laboratory, UK "Conjugation of fluorescent dyes changes the adsorption behaviour of proteins".

Tuesday 15th May 2012 (Continued)

Time:	**10:40 am to 12:30 pm**
Session Title (**TU2**):	**Molecular Orientation and Structure**
Invited Talk:	Professor David G. Castner, University of Washington, USA "Strategies for Structural Analysis of Surface Bound Peptides and Proteins".
Contributed talk (Each 15min): (Followed by Discussion)	Dr. Giacomo Ceccone, Institute for Health and Consumer Protection, Italy "Measuring Protein Structural and Stability Changes upon Protein-Nanoparticle Interactions". Mr. Kwasi Kwakwa, National Physical Laboratory, United Kingdom "Measuring the 3-D orientation of fluorescent molecules embedded in synthetic lipid bilayers".

Time:	**1:30 pm to 3:20 pm**
Session Title (**TU3**):	**Emerging Methods I**
Invited Talk:	Dr. Heike Arnolds, University of Liverpool, UK "Advances in nonlinear optical spectroscopy of molecules at interfaces: Can anyone do it?".
Contributed talk (Each 15min): (Followed by Discussion)	Dr. Matthias Müller, Physikalisch-Technische Bundesanstalt, Germany "Investigation of the Adsorption of Self-assembled Monolayers on Germanium Surfaces by Near Edge X-ray Fine Structure Spectrometry". Ms. Cara Barnes, University of Utah, USA "Enhanced Two Photon Processes for Molecule Localization on Plasmonic Nanocrescents".

Time:	**3:40 pm to 4:30 pm**
Session Title (**TU4**):	**Summary Poster Session to capture discussions.**

Time:	**4:30 pm to 6:30 pm**
Session Title (**TU5**):	**EMRP Kick-Off Meeting**

Wednesday 16th May 2012

Time:	**8:30 am to 10:45 am**
Session Title (**WE1**):	**Functional Surfaces**
Invited Talk:	Professor Janos Vörös, ETH Zurich, Switzerland "Ions, molecules, and cells at electrodes".
Contributed talk (Each 15min): (Followed by Discussion)	Professor Morgan Alexander, University of Nottingham, UK "The Role of Albumin and Fibronectin in the Adhesion of Fibroblasts to Plasma Polymer Surfaces". Mr. Oleksii Ivashenko, University of Groningen, The Netherlands "A spectroelectrochemical study of the redox and photochemical functionality of the spiropyran-merocyanine molecular switch in solution and in self-assembled monolayers". Dr. Abbasi Gandhi, Materials and Surface Science Institute, University of Limerick, Ireland "Selective protein absorption on electrically modified hydroxyapatite: probing with a kelvin force probe and confocal microscope".

Time:	**11:15 am to 12:30 pm**
Session Title (**WE2**):	**Contributed Poster Session**

Time:	**1:30 pm to 4:30 pm** **Excursion** to Beeston Castle / Chester City Tour followed by Falconry at the Peckforton Castle.

Time:	**6:30 pm to 7:30 pm** **Pre-dinner drinks.**

Time:	**7:30 pm onwards** **Banquet Dinner** at the Great Hall.

Thursday 17th May 2012

Time:	**8:30 am to 10:20 am**
Session Title (**TH1**):	**Emerging Methods II**
Invited Talk:	Professor Fredrik Höök, Chalmers University of Technology, Sweden "Single molecule detection and equilibrium fluctuation analysis using fluorescent lipid vesicles as signal enhancement elements".
Contributed talk (Each 15min): (Followed by Discussion)	Dr. Peter Sjövall, SP Technical Research Institute of Sweden, Sweden "Multiplexed biomolecule detection using liposome binding and mass spectrometry imaging". Dr. Michael Krumrey, PTB, Germany "Size Determination of Nanoparticles with Synchrotron Radiation-based SAXS".

Thursday 17th May 2012 (Continued)

Time:	**10:40 am to 12:30 pm**
Session Title (**TH2**):	**Industrial applications and needs**
Invited Talk:	Dr. Matthew Wagner, The Procter & Gamble Company, USA "Industrial Needs and Practical Considerations for the Measurement of Adsorption at Interfaces".
Contributed talk (Each 15min): (Followed by Discussion)	Dr. James Noble, National Physical Laboratory, UK "Characterization of Biomolecule coated nanoparticles for Diagnostic Tests". Dr. Marie-Laure Abel, University of Surrey, UK "The Utility of Adsorptions Isotherms in Adhesion Science".

Time:	**1:30 pm to 3:20 pm**
Session Title (**TH3**):	**Optical Methods I**
Invited Talk:	Professor Jennifer Shumaker-Parry, University of Utah, USA "Plasmonic Architectures for Challenges Related to Adsorption Measurements of Complex Samples and Small Molecules".
Contributed talk (Each 15min): (Followed by Discussion)	Professor Laura M. Lechuga, Research Center on Nanoscience and Nanotechnology, Spain "Surface tailoring of highly specific optical biosensors". Dr. Björn Agnarsson, Chalmers University of Technology, Sweden "Evanescent-wave excitation using a planar waveguide".

Time:	**3:40 pm to 5:30 pm**
Session Title (**TH4**):	**Optical Methods II**
Invited Talk:	Professor Mathias Schubert, University of Nebraska-Lincoln, USA "New chemical, biochemical and biological sensing and separation principles based on highly ordered three-dimensional nanohybrid materials thin films".
Contributed talk (Each 15min): (Followed by Discussion)	Dr. Peter Schierack, Lausitz University of Applied Sciences, Senftenberg, Germany "A Highly Versatile Microscope Imaging Technology Platform for the Multiplex Detection of Biomolecules". Professor André Peremans, Facultés Universitaires Notre-Dame de la Paix, Namur, Belgium "Far-field optical vibrational micro-spectroscopy with sub-diffraction resolution".

Time:	**5:45 pm to 6:30 pm**
Session Title (**TH5**):	**Summary Poster Session to capture discussions.**

Friday 18th May 2012

Time:	**8:30 am to 10:20 am**
Session Title (**FR1**):	**Quantitative Analysis**
Contributed talk (Each 15min): (Followed by Discussion)	Dr. Alex Shard, National Physical Laboratory, UK "XPS analysis of adsorbed proteins". Dr. Anouk Galtayries, Laboratoire de Physico-Chimie des Surfaces, ChimieParisTech, France "Combining quantitative XPS and QCM techniques: elaboration of surface mechanisms in corrosion and protein adsorption". Dr. Paul Dietrich, Federal Institute for Materials Research and Testing, Germany "How successful is surface chemical analysis in the characterization of (model) diagnostic devices exploiting probe-target interaction?".

Time:	**10:40 am to 12:30 pm**
Session Title (**FR2**):	**Summary and Panel Discussion**
Chair:	Dr. Alex Shard, National Physical Laboratory, UK

Sponsors

The main sponsor of the workshop is the **International Union for Vacuum Science Technique and Applications (IUVSTA)**.

Other Major Sponsors

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