

Welcome from the Chair

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Dear members

Welcome to the 2016 newsletter from the Thin Films and Surfaces Group (TFSG) of the IOP. This year lay between our flagship biennial Interdisciplinary Surface Science Conferences (ISSC) so we instead concentrated on supporting smaller conferences and workshops, and we organised our own PhD student summer school. The conference reports in the following pages highlight the cross-disciplinary nature of our area of work. For example, we supported Theory Meets Experiment: Molecular Nanoscience and Applications, organised by the IOP Nanoscale Physics and Technology group; the Royal Society of Chemistry 'Imaging Surfaces' symposium; and VS6: Emerging Technologies in Vacuum Science, which we co-supported with four other IOP groups.

Our highlight event of the year was the extremely successful Summer School on nanoScience@Surfaces which was held in the Cavendish Laboratory at the University of Cambridge on 1-4th August. The School was primarily aimed at PhD students carrying out research involving the study of surfaces and interfaces at the atomic and molecular scale, including Condensed Matter Physics, Material Science and Physical Chemistry. All speakers were invited, including Professor Anders Nilsson from Stockholm University and Professor Fulvio Parmigiani from University of Trieste, along with a mixture of distinguished and early-career UK speakers. In total there were

85 delegates from 13 different countries, and the feedback on the School was overwhelmingly positive. Our next Interdisciplinary Surface Science Conference is ISSC-21, held in Manchester on 10-13th April 2017. As usual we have an outstanding array of invited speakers covering all experimental and theoretical aspects of surfaces, interfaces and nanoscale physics and chemistry. During the meeting, the Annual General Meeting (AGM) of the TFSG will be held, with new committee posts being elected. Any member of the TFSG is eligible to stand for a post. If you wish to take an active role in the TFSG, attending the AGM is a great place to start.

In my welcome to the last TFSG Newsletter I raised the concern that despite the importance of the field of thin films and surfaces to technology and to fundamental science, the term 'surface science' had become unfashionable in some circles, with the Engineering and Physical Sciences Research Council (EPSRC) listing it as an area where they are de-prioritising funding. Since then the EPSRC commissioned a review of all the subject areas they fund (called Balancing Capabilities), soliciting evidence from a variety of sources, including learned societies. The TFSG subsequently submitted a 17-page report in support of the surface science community and members also attended an EPSRC Surface Science Focus Group. While the conclusions from the Balancing Capability



review are not due until January, the feeling is that surface science represented itself well.

Finally, I would like to remind you of some of the opportunities provided by the group, about which you can read below. The annual Surface Science Lecture Series provides the possibility for you to host a funded overseas speaker to give a seminar at your institution on a topic of interest to the surface science community. The Woodruff Prize is a chance to recognise an exceptional PhD thesis in the general field of surface science and student bursaries are available for conference attendance.

Best Regards,

Neil Curson (Chair of the TFSG)

London Centre for Nanotechnology

UCL

(n.curson@ucl.ac.uk)

Reports on Meetings Organised by the TFSG

Summer School on nanoScience@Surfaces

The Summer School on nanoScience@Surfaces was held in the Cavendish Laboratory at the University of Cambridge, 1-4th August 2016. The summer school was organised and sponsored by the IOP Thin Films and Surfaces Group. The meeting was co-sponsored by the IOP Vacuum Group, the RSC Solid Surfaces Group, Scienta Omicron and the Centre for Doctoral Training in Advanced Characterisation of Materials at UCL and Imperial College London.

The School was primarily aimed at PhD students carrying out research involving the study of surfaces and interfaces at the atomic and molecular scale, including Condensed Matter Physics, Material Science and Physical Chemistry. In total there were 85 delegates from 13 different countries. The School included a combination of lectures, research talks and workshops which covered the basics of experimental and computational techniques which may be applied to surface science and engineering. It also included a poster competition, a careers session and several social activities including a conference meal at The Old Courts main hall at Gonville and Caius College.

The invited speakers included 2 international speakers, Professor Fulvio Parmigiani (University of Trieste) and Professor Anders Nilsson (Stockholm University). There were many other UK speakers including Professor Wendy Flavell (The University of Manchester), Dr Rachel Oliver (University of Cambridge), Dr Bill Allison (University of Cambridge), Dr Katie Moore (The University of Manchester), Dr Andrew Thomas (The University of Manchester), Dr Ron Reid, Professor Angelos Michaelides (UCL), Professor Geoff Thornton (UCL), Professor Martin McCoustra (Heriot-Watt University), Dr Giovanni Costantini (University of Warwick), Dr Natalie Belsey (National Physical Laboratory) and Professor Martin Castell (University of Oxford).

During the summer school, delegates were able to choose 2 workshops to attend from the 3 workshops available. These were; STM image analysis run by Dr Joe Smerdon (University of Central Lancashire), CasaXPS analysis run by Dr Andrew Thomas (The University of Manchester) and CASTEP/Materials Studio run by Felix Hanke (Biovia). The STM image analysis and CasaXPS analysis workshops were "hands-on" sessions. Delegates learned about the techniques and tried their hand at analysing some data with advice and guidance from the workshop providers. The CASTEP/Materials studio workshop was an interactive demonstration session where delegates learned about DFT calculations for surface science applications.

At the poster competition there were prizes for first, second and third place available. First place was awarded to Neil Robinson (University of Cambridge) for his poster "Two-dimensional NMR relaxometry as a non-invasive tool for comparing adsorption strengths in silica-supported catalysts". Second place went to Matthew Bergin

(University of Cambridge) for his poster "Imaging surfaces with helium". Joint third place was awarded to Zoe Henderson (University of Central Lancashire) for her poster "Water-cation interactions in ionic liquid multilayers: a near-ambient pressure X-ray photoelectron spectroscopy study" and Dario Valter Conca (UCL) for his poster "Investigation of the molecular interactions relevant to receptor-mediated virus entry using HIV receptors as a model".

On the final day, delegates took part in a careers "speed dating" event. There was an introductory talk from Vishanti Fox, careers and CPD manager at the IOP, about the help and guidance available for PhD student members. Delegates were then split into 6 groups and had about 15 minutes to chat informally with each of the 6 speakers. The speakers were Dr Kieran Cheetham (NSG), Dr Cerianne Whitehead (AkzoNobel), Dr James Dutton (Plasma Quest), Dr Jon Treacy (Thermo Fisher Scientific), Dr Mark Jackman (Domainex) and Dr Natalie Belsey (NPL). The idea of this careers session was to allow students to discover what opportunities there are outside of academia for people with their skills.

In the final session of the conference, Professor Martin McCoustra, acting in his capacity as vice-chair of the British Vacuum Council, awarded Professor Martin Castell the British Vacuum Council Senior Prize and John Yarwood Memorial Medal.

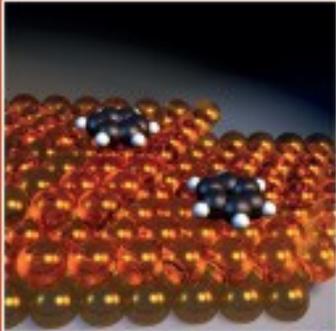
By the end of the week there was some discussion about turning the summer school into a regular event and running it every 3 years. Thank you to all the organisers and sponsors who made this event possible and to the enthusiastic group of students who attended.

Karen Syres

(Conference chair)

August 2016





Interdisciplinary Surface Science Conference (ISSC-21)

10-13 April 2017
Royal Northern College of Music,
Manchester, UK

<http://issc-21.iopconfs.org>

Reports on Meetings Sponsored by the TFSG

VS6: Emerging Technologies in Vacuum Science

Held on 14th October 2015 at the Ricoh Arena in Coventry, this meeting was organised as a joint venture by 5 subject groups of the Institute of Physics (Ion and Plasma Surface Interactions, Materials and Characterisation, Nanoscale Physics and Technology, Thin Films and Surfaces, and, Vacuum)

The aim of the meeting was to look at recent developments in science which are traditionally based on the use of a vacuum environment. The meeting was well attended with about 50 delegates who enjoyed the presentations and triggered much discussion.

The first paper by Joachim Schnadt from Lund University, Sweden described recent developments in a technique to operate x-ray photoelectron spectroscopy at near-ambient pressures (circa 1 mbar), thus increasing the range of materials that can now be analysed using this method and allowing some observations whilst chemical reactions are taking place. Electron spectroscopies usually require a good vacuum. Susannah Speller explained the importance of analytic microscopy in determining the relationships between chemistry, micro-structure and properties of superconducting materials including lead-free superconducting joints essential for superconducting magnets and Holly Hedgeland described the development of a scanning helium microscope which gives surface sensitive images with sub-micron resolution without surface damage and, using helium atoms, no surface charging problems. Holly also explained the operation of a Helium Spin echo Spectrometer which provides information on the picosecond surface dynamics of diffusion and vibration and allows basic parameters, such as adsorbate-substrate friction, to be compared with theoretical model values. Progress in the understanding of the performance of another vacuum-based analysis method, UHV Atomic Force Microscopy, was described by Adam Sweetman. Intermolecular contrast can be seen related to the hydrogen bonding between molecules but Adam showed that a detailed understanding of the coupled tip-molecule system and tip structure is needed to interpret these results.

Stuart Davidson described the progress toward a new definition of the kilogram mass which does not require reference to a material artefact such as the current Platinum cylinder. Two routes are being

developed; one uses the Avogadro number and is realised via a sphere of single crystal silicon, the other uses the Watt balance in a vacuum and relates the measured force via Planck's constant to the kilogram. Both experiments realise the kilogram in vacuum. The accuracy of both methods is now better than the required 2 parts in 10^8 and it is expected that the redefinition will be ratified in 2018.

The applications of phase change materials, chalcogenide glasses such as GeSbTe (GST) and AgInSbTe were described by Harish Bhaskaran. When a current flows through a layer of GST which is sandwiched between 2 layers of Indium-Tin-Oxide crystalline to amorphous transition occurs and optical reflectance over a narrow wavelength increases with potential application to, for example, smart windows. Phase change materials with possible application as tunable resonators were also discussed. Glen West showed that the anatase phase of TiO₂ was required for photocatalytic activity, with applications such as self-cleaning materials, the reduction of atmospheric pollution and splitting of water to produce hydrogen fuel. However, its large band-gap requires UV illumination to induce catalysis. By doping the TiO₂ with various metal and non-metallic elements the band-gap can be modified to allow utilisation of visible and near-visible radiation present in artificial lighting and sunlight, thus extending the applications available. Also, by using High Power Impulse Magnetron Sputtering the deposition temperature can be significantly reduced to enable deposition onto polymeric materials and multi-functional, multi-layer devices. James O'Shea described a UHV-compatible electrospray method for deposition of non-volatile molecules. The technique opens up a wide field of study of the interaction of large molecules, such as polymers, some organometallic complexes, proteins and nanoparticle clusters, with an atomically clean surface in UHV which allows a new range of surface science study to be undertaken.

I would like to thank Sue Waller and Marie White and members of the ASTeC group in Daresbury Laboratory for their valuable help with this meeting.

John Colligon

October 2015

RSC Imaging Surfaces

On Wednesday 21st January 2015, the Solid Surfaces Group of the Royal Society of Chemistry organised a symposium entitled "Imaging Surfaces" held at Burlington House in London. The meeting was attended by sixty delegates and consisted of invited talks from Professor Geoff Thornton (UCL), Dr Chris Baddeley (University of St Andrews) and Professor Maya Kiskinova (Elettra Sincrotrone, Trieste, Italy). Prof Thornton described his research into imaging metals on reducible metal oxide surfaces with scanning tunnelling microscopy (STM). Dr Baddeley described the use of STM to characterise metal-organic and covalent-organic architectures

grown on metal surfaces. Prof Kiskinova discussed recent advances of synchrotron-based photoelectron microscopy in addressing surface properties of morphologically complex systems and nano-structures. In addition, a number of talks and posters were presented by PhD students and PDRA's from UK-based research groups covering a broad range of topics utilising a number of imaging techniques including STM, atomic force microscopy and helium atom microscopy. The talks and posters prompted lively scientific discussions. The organisers of the meeting were grateful for sponsorship from the Thin Films and Surfaces Group of the Institute of Physics, Scanwel Ltd and Hiden Analytical Ltd.

Theory Meets Experiment: Molecular Nanoscience and Applications

Theory Meets Experiment: Molecular Nanoscience and Applications was a three day conference held at University College London 1-3 June 2015 (<http://tmemna2015.iopconfs.org/home>), chaired by Steven Schofield and Cyrus Hirjibehedin. The meeting was organised by the Nanoscale Physics and Technology (NPT) group of the IOP and supported by the Thin Films and Surfaces (TFS) group. The main financial sponsor was the Engineering and Physical Sciences Research Council (EPSRC). There was a focussed exhibition from commercial sponsors: NT-MDT; Sigma Surface Science; SPECS; Windsor Scientific. There were over 30 oral presentations from an excellent list of national and international researchers, including invited presentations from Harald Brune (EPFL, Switzerland); Andrew Fisher (University College London, UK); Katharina Franke (Free University of Berlin, Germany); Lev Kantorovich (Kings

College London, UK); Mats Persson (University of Liverpool, UK); Damien Riedel (University of Paris-Sud, France); François Rochet (Pierre and Marie Curie University, France); Tamar Seideman (Northwestern University, USA); Roberta Sessoli (University of Florence, Italy); Latha Venkataraman (Columbia University, USA); Ayelet Vilan (Weizmann Institute of Science, Israel); Jörg Zegenhagen (Diamond Light Source, UK); Linghong Zhang (University of Wisconsin-Madison, USA). The oral sessions were complemented by an evening poster session, and social and networking sessions including two evening buffet meals and a midday excursion to the London Eye. This meeting was the second in the "Theory Meets Experiment" series organised by the NPT group, following the successful "Theory meets experiment: organic molecules on inorganic surfaces" in 2013, and preceding "Nanomaterials for Technology Theory Meets Experiment" held at the University of Strathclyde 20 & 21 June 2016.



Nanoparticle Concentration, Chemistry and Interfaces

Nanoparticle Concentration, Chemistry and Interfaces was held at Peckforton Castle, Cheshire on 20-24th April 2015 and attracted 65 participants from 18 countries, with representatives from national metrology institutes, academia and industry. The workshop included in-depth keynote presentations, oral and poster contributions and dedicated sessions for open discussion, including a 'brainstorming' session. In addition to the stimulating scientific programme, delegates were treated to a falconry display with excursions to Beeston Castle or Chester.

A number of pertinent issues were addressed during the event, such as reproducible methods for synthesis and sample preparation, reference materials, the best approaches for characterisation of properties such as particle size, shape, chemistry and concentration. Their growing use has also given rise to some concern over their

impact upon health and the environment. Nanoparticle surface chemistry is a complex and dynamic property, affected by the nanoparticle's environment, and directs nanoparticle behaviour. There is a pressing need to understand, compare and standardise the best methods for design, manufacture and measurement of the interfacial chemistry of particles. Knowledge of the accurate number concentration of particles is also a pressing concern in regulatory environments, (e.g. EU legislation), and no validated or traceable measurement method currently exists.

This workshop provided a unique forum to bring together these communities to discuss these challenges and the advantages and drawbacks of the various methods and the theories by which physically meaningful information can be extracted from data. Outputs from the meeting will form a publication in addition to informing technical committees such as ISO and VAMAS on nanomaterials and surface chemical analysis.

Thin Films & Surfaces Lecture Series

The Thin Films and Surfaces Group (TFSG) Lecture Series enables universities in the UK to bring a European or international inspirational surface scientist to give a lecture at their institution, open to all the surface science community to attend free of charge.

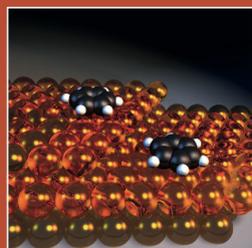
We are looking to entice the 'big names' in our field and promising Early Career Researchers. The lectures should be aimed to a wider audience beyond a narrow sub-field will be publicised to all members of the Thin Films and Surfaces Group of the IOP and must be open to attendees outside of the host institution (subject to the capacity of the available venue).

To facilitate this series, funds can be requested from the Thin Films & Surfaces Group to contribute towards the travel costs of the invited speaker. Up to three separate lectures will be funded each calendar year. Groups inviting Early Career Researchers to present their work are particularly encouraged to apply.

The 2016 lecture was given by Dr Barbara A. J. Lechner of the Lawrence Berkeley National Laboratory and Technical University Munich on 3rd November at the Cavendish Laboratory in Cambridge and was entitled "Crystalline growth of ice – Restructuring of the first wetting layer during multilayer formation". Dr Lechner presented an STM study of the change in order seen in the structure of ice as it grows from monolayer to multilayers on Pt(111) and Ru(0001), and how co-adsorption of ammonia affects the process.

The call for funding for 2017 is now open and applications will be presented to the IOP General Fund, provided they meet the rigorous standards of the call and are approved by the TFSG Committee. For this round, funds of up to £300 for a speaker from Europe, or £500 for an international speaker may be applied for.

Application forms can be requested from the Chair of the TFSG, Neil Curson.



Interdisciplinary Surface Science Conference (ISSC-21)

10–13 April 2017

Royal Northern College of Music, Manchester, UK

Organised by the IOP Thin Films and Surfaces Group

ISSC-21 is the latest meeting in the series of interdisciplinary surface science conferences covering all experimental and theoretical aspects of surfaces, interfaces and nanoscale physics and chemistry.

Invited speakers

- Alex Bradshaw, Fritz Haber Insitut, Germany
- Cristiana di Valentin, Università degli Studi di Milano-Bicocca, Italy
- Vladimir Falko, University of Manchester, UK
- Wendy Flavell, University of Manchester, UK
- Mark Golden, University of Amsterdam, Netherlands
- Yvonne Grunder, University of Liverpool, UK
- Philippe Marcus, CNRS, France
- Angelos Michaelides, University College London, UK
- Richard Palmer, University of Birmingham, UK
- Miquel Salmeron, University of California Berkeley, USA
- Christof Wöll, KIT, Germany

Organising Committee

- Rob Lindsay (Manchester) co-chair
- Andrew Thomas (Manchester) co-chair
- Heike Arnolds (Liverpool)
- Hajo Freud (Fritz-Haber Institute, Berlin)
- Wolfgang Theis (Birmingham)
- Geoff Thornton (University College London)

Abstract submission

Contributions for oral and/or poster presentations are invited. Abstracts of a maximum of 500 words should be submitted online at <http://issc21.iopconfs.org/abstracts> by 9 December 2016.

<http://issc21.iopconfs.org>

Woodruff Thesis Prize 2015: Winners

The 2015 Woodruff thesis prize (awarded for a thesis submitted in the 2015 calendar year) has for the first time been awarded jointly. The two winners are Dr Hannah Aitchison from University of St Andrews, with a thesis entitled “Self-Assembly of Monolayers of Aromatic Carboxylic Acid Molecules on Silver and Copper Modified Gold Surfaces at the Liquid-Solid Interface”, and Dr Demian Marchione from Heriot-Watt University, whose thesis describes “Thermal and Non-Thermal Processes of Simple Molecules on Model Interstellar Ices”.

Dr Aitchison’s thesis explores new directions in the design and application of self-assembled monolayers (SAMs), exploiting coordination bonding of aromatic carboxylic acids at metal surfaces. The SAMs are investigated using a multi-technique approach comprising of a complementary combination of scanning tunneling microscopy (STM), X-ray photoelectron spectroscopy (XPS) and near-edge X-ray absorption

fine structure (NEXAFS) spectroscopy. In addition, the X-ray standing wave technique (XSW) was used to characterise the substrates.

Dr Marchione’s thesis studies the thin film growth and desorption behaviour of simple molecules by means of surface science techniques such as mass spectrometry, temperature programmed desorption and reflection-absorption infrared spectroscopy (RAIRS), in order to understand the physio-chemical processes and intermolecular interactions in model interstellar ices. The systems of interest comprise a silica surface, representing the bare grains in the interstellar medium, and films of water (H₂O), methanol (CH₃OH), diethyl ether ((CH₃CH₂)₂O) and benzene (C₆H₆).

We also congratulate Dr Ada Della Pia who was the winner of the 2014 Woodruff Prize which was awarded after publication of the previous Newsletter. Dr Della Pia, who is now a Postdoc at

Sapienza University of Rome, carried out her PhD at the University of Warwick and was awarded the Prize for a thesis entitled “Using electrostatic interactions to control supramolecular self-assembly at surfaces.”



Dr Hannah Aitchison, joint-winner of the 2015 Woodruff thesis prize.



Dr Demian Marchione, joint-winner of the 2015 Woodruff thesis prize.

Woodruff Thesis Prize 2016: Call for nominations

The Woodruff thesis prize is awarded annually by the Thin Films and Surfaces Group (TFSG) of the Institute of Physics (IOP) for the best PhD thesis completed by a student member of the TFSG in the stated year. The prize is £200 and an associated certificate.

Nominations must be made using an application form that can be obtained from the TFSG group website (http://www.iop.org/activity/groups/subject/tfsg/prize/page_50366.html) and submitted to the Chair of the TFSG (Neil Curson, email: n.curson@ucl.ac.uk) at any time

before the closing date of 30th April 2017. In addition to the application form, an electronic copy of the thesis should be submitted, with a small section identified that represents the highlight of the thesis. The qualifying period is the calendar year 2016 during which time the

thesis must have been successfully examined for a PhD and the final version submitted (theses originally submitted in 2015 are therefore eligible if they were examined in 2016).

TSFG Student Bursaries

The Institute of Physics (IoP) provides financial support to research students to attend international meetings and major national meetings.

The Institute of Physics handles the application process but it is the relevant IoP group that makes the decision on whether to award the bursary and its value.

Research Student Conference Fund (RSCF) bursaries are available to PhD students who

are a member of the Institute and of an appropriate Institute group.

Students may apply for up to £250 during the course of their PhD and may apply more than once, for example they may request the full amount or decide to request a smaller amount and then apply for funding again for another conference at a later stage.

Note that grants will normally cover only part of the expenses incurred in attending a conference and are intended to supplement grants from other sources.

For details and application form please look at the information for students on the iop.org website.

All recipients are asked to produce a report on return from their conference before receiving payment.

“Research Student Conference Fund (RSCF) bursaries are available to PhD students who are a member of the Institute and of an appropriate Institute group.”

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