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Welcome from the Chair

I am delighted to welcome you to the Winter 2019 edition of the IOP Thin Films and Surfaces Group newsletter.

The group has had a productive second half of 2019, with a range of activities covering the spread of interests in our field. In particular, the group has supported a number of diverse and exciting meetings, many of which are reported on in this edition of the newsletter.

We are also pleased to announce that the 2018 Woodruff Thesis prize has been awarded to Dr Peter Townsend (University of Cambridge) for his thesis entitled “Diffusion of light adsorbates on transition metal surfaces” (reported in more detail on page 6).

The 2019 prize is now open for nominations, so please do consider proposing strong PhD theses submitted this calendar year – it is a great way to recognise excellence in our field.

As we all know, Thin Film and Surface Science is becoming an increasingly diverse field, involving. To help support collaborations, we are also now including a newsletter section on facilities that may be of relevance to TFSG members. In this edition we have a short article on the medium energy ion scattering (MEIS) facility at Huddersfield, and the unique capabilities that it offers.

More generally, the committee is keen to hear how we can further support our community. Please do get in touch with us if you have suggestions, would like to

contribute article to the newsletter, or otherwise get involved.



Looking forward to next year, we again have an exciting programme. A particular highlight for student members will be the 2020 Summer School on nanoScience@Surfaces, due to be held in Liverpool in late July.

Best wishes for 2020!

Dr Andy Jardine

*TFSG Chair,
Department of Physics,
University of Cambridge*

TSFG Student and Early Career Bursaries

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

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 **£300** 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. All recipients are asked to produce a report on return from their conference before receiving payment. For details and application form please look at http://www.iop.org/about/grants/travel-bursaries/page_69141.html.

* Please note that bursaries are not available for meetings organised by the Institute of Physics including those organised by IOP Groups.

Ion and Plasma Surface Interactions (IPSI) Conference 2019 – Report

The regular IPSI Plasmas, Surfaces and Thin Films conference returned to the new Institute of Physics building in London on Jun. 12th, after a few years “on the road” around the UK. It was well attended and covered a wide range on the topics of technological plasmas, and how they are utilized for thin film deposition, controlled material removal (etching), what are their constituent parts and what role do ions play.

The oral programme consisted of four invites and three contributed talks. A slot was given over for the exhibitors to give a 2 minute description of what was on their stands, together with a presentation of the groups future planned meetings.

Five companies took up the offer of table top exhibition space and 11 posters were housed in the new atrium, where the catering was also served. The exhibitors were Hiden Analytical, PI-KEM, Loughborough Surface Analysis Limited, Plasma Quest, and Emerson & Renwick. The spacious area was convivial for discussions both with exhibitors and the poster presenters.

An introduction to the meeting described how the last few years the meeting took to the road and now back in London, where it started off back in the 1980s. It was felt appropriate that the instigator of the meetings, Mike Walls, should open the programme.

The morning session was chaired by Alan Webb and started with a talk on deposition methods for thin film solar cells from Loughborough University, focussing on different techniques to deposit CdTe solar cells, and its development over the years. The following presentation covered innovative roll-to-roll (R2R) solutions for coating development and production, from Emerson & Renwick, including case studies on wire grid polarisers and near-field communication (NFC) devices on steel substrates. The first session closed with a discussion on novel vacuum quality diagnostics based on plasma sensors from Gencoa.

The Group AGM was held directly after the session and was followed by lunch, together with the posters and exhibition.

The afternoon session was chaired by Hayley Brown and kicked off with an introduction to ion beam analysis at the UK National Ion Beam Centre, and a review of the multiple techniques available. Work on arsenic plasma doping and processing of

silicon, characterised by medium energy ion scattering, was presented from the University of Huddersfield. Plasma-cured vacuum-deposited acrylate coating at University of Oxford was explored, including potential applications such as smoothing layers for subsequent gas barrier layers. The final talk of the day was on vacuum processing in manufacture of hard-drive recording heads at Seagate Technology, focussing on heat-assisted magnetic recording (HAMR), due for commercial launch this year.

Two independent judges picked two winners, the Group prize and the BVC sponsored prize. The criteria used was that stated on the Group's web site. Winner of the IPSI student poster prize was Jake Prentice from the University of Southampton with the title “*Quantitative analysis of bi-directional ablation in pulsed laser deposition*”. Andrew Rossal from the University of Huddersfield won the BVC poster prize with his poster “*Examining the effect of the depth profile on the electrical properties of transition metal oxide thin films*”.

The meeting was organised by Hayley Brown (Plasma Quest), and Alan Webb (Consultant). It was kindly sponsored by the IOP Vacuum and Thin Films and Surfaces Groups and the British Vacuum Council (BVC). A gallery of photos from the meeting is available online [here](#).

Dr Alan Webb, *Consultant*
Dr Kieran Cheetham, *STFC*



IPSI conference, at the new IOP building in London

COMING SOON

- **Apr.:** High-pressure XPS of Energy Materials (exact date and place to be confirmed).
- **Jun. 10th:** Ions and Plasma in Structuring of Surfaces and Thin Films, London.
- **Jul.:** Summer School on nanoScience@Surfaces, Liverpool (exact date to be confirmed).
- **Jul. 20-22nd:** [UK Colloids 2020](#), Liverpool.

Thin Film Coatings for Electro-optics 2019 – Report

The inaugural Thin Film Coatings for Electro-optics meeting was held at the Foresight Centre in Liverpool on 5th Sept. 2019, and was chaired by Dr Kieran Cheetham. It was designed to bring together researchers from different disciplines, and covered topics such as thin film lighting and displays, glass coatings, precision optical coatings, and thin films for renewable energy applications. The format included four invited speakers, as well as five contributed talks, plus a variety of posters. There was also a small exhibition from some of the sponsors.

The first session focussed on displays and optical coatings:

- ‘SRD: A new generation of full colour, video capable, reflective displays’
- ‘Recent advances in plasma ion assisted deposition of optical thin films’
- ‘Thin film filters in security and defence’

The second session focussed on transparent conductive coatings and photovoltaics:

- ‘Inorganic CdTe Thin Film Photovoltaics enabled by MOCVD’
- ‘High electron mobility transparent conducting coatings using novel dopants’
- ‘Enhancements in AZO Deposition using Remote Plasma Sputtering’

The final session focussed on coating control and novel materials:

- ‘State-of-the-art Control Methods for the Deposition of Optical Thin Films’
- ‘Chemical Control of Correlated Metals as Transparent Conductors’
- ‘LPE Growth of GaAsSbN for Multi-Junction Solar Cells’

The poster prize was awarded to Jessica Stoner, University of Liverpool, at the start of the third session. The event ended with a networking drinks reception, giving participants the chance to exchange ideas. The attendees were a mix of industrialists and academics, including PhD students, and overall the event was well received.

The event was organised by the IOP Thin Films and Surfaces Group, and sponsored by the Optical,

IPSI, and Semiconductor Physics Groups. It was also sponsored by Light Coatings Ltd, Gencoa Ltd, the Stephenson Institute for Renewable Energy, and the UK National ION Beam Centre.

Dr Kieran Cheetham
Science and Technology Facility Council



Stephen Stanley presents certificate to poster prize winner Jessica Stoner

Molecules at Surfaces: What do we really know? – Report

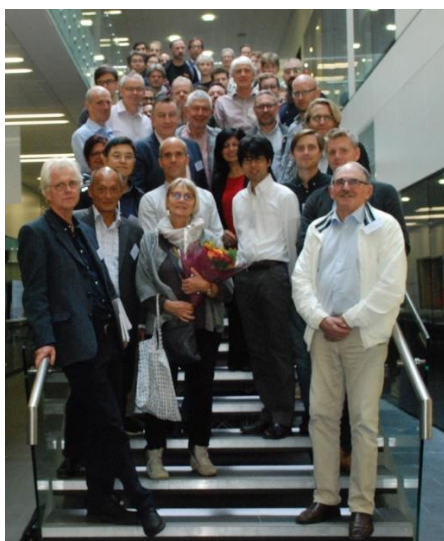
On the 12th and 13th of September the symposium “[Molecules at Surfaces: What do we really know?](#)” was held at the University of Liverpool in honour of Prof Mats Persson, who has retired this year. A selection of Mats’ past collaborators, colleagues, students and post-docs were invited to present their latest research in the field, along with reflections on working with him. They were joined by Mats and his family (his wife and three sons), and attendees from across the UK and beyond.

There were many [highlights](#) over the two days, including the discovery that it is now possible to image chemical bonds present in molecules and surfaces, with perhaps even tantalising glimpses of non-bonding interactions (Prof Wilson Ho), that we can observe chemistry on surfaces occurring on a fs timescale (Prof Shiwu Gao), and that there is a strong correlation between co-authoring a paper with Mats and receiving tenure. The quality and breadth of presentations meant that the symposium was widely appreciated.

Towards the end of the meeting, Prof Neil Berry, head of the Chemistry Department at Liverpool, presented Mats with gifts representing the warmth and gratitude of his colleagues at the University, and announced that he would retain the status of Emeritus Professor. Over the course of the meeting Mats received as many invitations to continue working with past collaborators, as wishes that he enjoys a retirement away from Science. There was a strong hope and expectation that the community represented at the symposium will continue to push at the forefront of surface science, working away at “what we don’t know” about molecules at surfaces, even if we are no longer able to turn to Mats to ask him “what do we know?”.

The organisers would like to thank the following organisations for their financial support: The University of Liverpool, CCP5, the RSC Interest Group for Solid Surfaces, N8 CIR, Diamond Light Source, and the IOP Thin Films and Surfaces Group.

Dr Matthew Dyer
University of Liverpool



Group photo of the symposium “Molecules at Surfaces: What do we really know?”, held at the University of Liverpool in honour of Prof Mats Persson

VASP Workshop on the Computational Modelling of Electronic Structure of Surfaces and Interfaces – Report

A computational workshop related to electronic structure modelling of materials surfaces and interfaces using the [VASP](#) code was held on Oct. 22-23,

at Riverside Innovation Centre of the University of Chester. The level was appropriate to PhD students and Postdocs, as well as researchers who wanted to enter in the field of materials’ surface and interface modelling. There were 38 attendees and 5 invited speakers, including two VASP developers from the University of Vienna, Austria. Participants came mostly from the UK and EU and there was also one participant from Taiwan. They were all from diverse scientific backgrounds, such as physics, chemistry and materials science with interests in applications relevant to optoelectronic devices, catalysis, fuel cells, etc. It was financially supported by TFSG, which provided the means to keep attendees’ fee to a minimum of £30 for IOP members and £50 for non-members. Lectures were delivered in the morning and hands-on sessions in the afternoon.

The Edinburgh Parallel Computing Centre ([EPCC](#)) donated 36 computing cores per participant to use for 6 hours during hands-on sessions, which provided computational power of almost 10,000 CPU hours’ worth of calculations. A [website](#) and a [wiki-page](#) were created specifically for the needs of the workshop. After the end of the workshop participants filled in a questionnaire anonymously, rating the overall organisation as either excellent or very good.

The organiser is grateful for support coming from the TFSG, EPCC and the Faculty of Science and Engineering of the University of Chester.

Dr Theodoros Papadopoulos
University of Chester



Group photo of the VASP computational workshop on the electronic structure of surfaces and interfaces held at Riverside Innovation Centre, University of Chester

Physics-based Contributions to new Medical Techniques (PCMT) – Report

This [one-day meeting](#) was proposed by Prof John Colligon of the Ion and Plasma Surface Interactions Group in view of the rapid development and announcement of new medical methods during the last 12 months. It was held at the Institute of Physics, London, on Nov. 27th, 2019. The aim was to bring Medical experts, who develop these new procedures, and Physicists, who develop improved analysis methods, together to discuss these methods and to identify areas where more progress is needed.

The event was supported by the following seven IOP groups: Ion and Plasma-Surface Interactions, Vacuum, Medical Physics, Particle Accelerators and Beams, High Energy Particle Physics, Materials and Characterisation, and Thin Films and Surfaces. Unfortunately Medical Physics later found, they were not able to support the meeting. IOP Conferences, (Claire Garner and colleagues), did a great job with the meeting admin and I would like to thank them for their valuable guidance. They advised that the attendance was good for a one-day event.

I was able to attract the following two exhibitors, who took display stands (i) Roger Webb, University of Surrey, promoting a new European network of available ion beam facilities called “Radiate”, and (ii) Cosylab, with a base in Slovenia, which makes control modules that can be adapted to operate Proton Beam Therapy systems and other Medical Devices.

I decided to hold a discussion session at 9.15 to give some background to recent activity in this field. Interesting developments discussed were related to (i) improved interventional and diagnostic imaging by using high-performance low-field-strength MRI, by A. E. Campbell-Washburn, (ii) An effective speech algorithm and brain imaging reported by Prof Chang, University-College, San Francisco, (iii) Real-time measurements of sweat rate and electrolytes and metabolites in sweat by Bizen Maskey, Sunchon National University, (iv) The role of the gut microbiome in aiding or protecting us from disease by Sameer Sonkusale, Tufts University.

Speakers and delegates have all indicated that they found this meeting very useful and informative and suggested that they would support a second similar event, perhaps in two years’ time. On the train home I began to wonder how surgeons control the depth of protons used in “Proton Beam Therapy.

They can certainly perform a low dose test-run at the start where protons are bombarding cancerous tissue and they do know the initial depth from subsequent analysis. However, very quickly, they are bombarding damaged material which is body tissue plus implanted protons. This means some of the incoming protons now hit protons and the range must become less. Will deeper parts of the tumour survive because they receive a lower total dose? Of course subsequent MRI will check this but it could mean a second radiation. Your views on LinkedIn may be interesting!

Prof John Colligon
University of Huddersfield

Advances in Photovoltaics 2019 – Report

Advances in Photovoltaics took place for the first time at the new IOP headquarters in London on 25th Sept 2019, and attracted about 60 attendees. This annual meeting is organised by Prof Michael Walls as part a joint event between the Institute and the EPSRC Supergen SuperSolar Hub.

Among the UK speakers, David Scanlon (UCL) provided an excellent overview on how computational chemistry can identify new high mobility Transparent Conductors for use in a variety of solar cell technologies. Jon Major (Liverpool) considered the development and potential of Antimony Selenide as a new absorber for thin film photovoltaics. Tom Fiducia (Loughborough) gave a talk on the detailed analysis of the new high efficiency selenium alloyed cadmium telluride. By using a combination of techniques including NanoSIMS, Cathodoluminescence and Transmission Electron Microscopy, he was able to show that Selenium actually passivates bulk defects in the cadmium telluride. This is the first direct observation of this effect and the hope is that the insights will lead to further process improvements.

Maikel Van Hest (NREL) was the keynote speaker. Maikel is working on scaling perovskite photovoltaics using solution processing and roll-to-roll printing of devices. The techniques have the potential to use paper printing technology to manufacture high efficiency photovoltaics at TW scale from a small footprint. NREL seem to have overcome already a number of significant obstacles.

Finally, Will Hitchcock, founder of Above Surveying Ltd, and world leader in assessing the health of solar assets, described the process of how a

drone is pre-programmed to fly over a solar asset and a thermographic camera captures thermal images from each module in the array. The images are then analysed and a report sent to the asset manager. The company is able to correlate a particular thermal signature with the defect causing it. Will reported that up to 20% of modules in UK solar farms are suffering from Potential Induced Degradation (PID). Fortunately, this fault can be reversed if identified in time. Above Surveying is growing fast and inspected more than 2GW of assets in 2019.

Prof Michael Walls
CREST, Loughborough University

Woodruff Thesis Prize 2018 Winner

The TFSG Committee was delighted to award the 2018 Woodruff Thesis prize to Dr Peter Townsend, University of Cambridge, for his thesis entitled “Diffusion of light adsorbates on transition metal surfaces”. His thesis involves both theoretical and experimental work and presents significant new insights into the dynamics of adsorbates on metals. In addition to a theoretical examination of Langevin dynamics and quantum diffusion, he presented detailed experimental Helium-3 Spin-Echo (HeSE) spectroscopy studies of carbon and oxygen on Ru(0001), as well as examining hydrogen and deuterium on several surfaces. The committee were particularly impressed, and described the work as being of an “exceptional standard”.



Peter Townsend, University of Cambridge, winner of the 2018 Woodruff Thesis Prize

EPSRC Established Career Fellowship

The Physical Sciences theme is currently welcoming Established Career Fellowship applications in the priority area of Surface Science. Through this fellowship priority area EPSRC aims to facilitate the development of strong leadership within the diverse surface science community to encourage the creation of a cohesive, integrated community of researchers.

As an Established Career fellow, you will be expected to deliver transformative fundamental research in this area, helping to ensure a strong core research capability for the future.

More details about the scope of the priority area are available online at the relevant EPSRC link [here](#). For any further questions or enquiries please contact Rosanna Greenop:
rosanna.greenop@epsrc.ukri.org

Call for Nominations for the Woodruff Thesis Prize 2019

Nominations for the Woodruff Thesis Prize 2019 are now open, with a closing date of 30th April 2020. The Woodruff prize is awarded annually for the best PhD thesis completed by a student member of the TFSG group in the stated year. The value of the prize is £250 and is established to encourage and recognise high quality research and scientific writing in the field of thin films and surfaces. Further information, is available online at the relevant IOP link [here](#).

Facilities relevant to TFSG

The MEIS Facility

The Medium Energy Ion Scattering (MEIS) facility, formerly at STFC's Daresbury Laboratory, was moved to the University of Huddersfield in 2012. It is now fitted with a new 200 keV ion accelerator and provides a powerful tool for the structural and compositional characterisation of surfaces and ultra-thin films, including depth profiling. The MEIS technique is based on the same principles as Rutherford backscattering, the energy of the scattered H and He ions being determined by the elastic recoil energy loss, dependant on the mass of the nucleus with which it collides, but also by the inelastic energy loss on its incoming and outgoing trajectories through the

material. However, a key difference from Rutherford scattering is that MEIS uses incident H and He ions at much lower energies (~50-200 keV), allowing greatly improved energy resolution of the scattered ion energies to be achieved through the use of an electrostatic dispersive energy analyser. This, in turn leads to greatly improved depth resolution. Specifically, it is capable of giving compositional and structural information as a function of depth with single atomic layer depth resolution.

For those interested to use the facility, please contact: sce.research.admin@hud.ac.uk

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