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# **IOP** | Institute of Physics

## **Ion and Plasma Surface Interactions Group**

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NEWSLETTER

December 2011

### Benefits of joining the IPSI Group

- [Fast access to news](#) in the ion and plasma surface interactions community; notification of upcoming meetings and conferences.
- Conference [bursaries and prizes](#) for students
- [Links](#) with researchers with similar interests
- [Funding and general support](#) for conferences and public engagement events
- Great for your [career](#) development
- Group Membership is [free](#) with your IOP membership, so join today!

### What does the IPSI Group do?

- Provides a forum for researchers working in ion and plasma surface interactions, allowing them to meet others with similar interests
- Supports the interests of these researchers on IoP Committees
- Organises and supports conferences related to ion and plasma surface interactions
- Sponsors students to go to conferences and gives prizes
- Communicates advances in plasma surface interactions to the community

<http://www.iop.org/activity/groups/subject/ipsi/index.html>

## **Welcome to the Ion and Plasma Surface Interactions (IPSI) Group Newsletter**

A message from the Chair:

Joining the IPSI Committee and being elected to Chair the Committee in June this year, was a whirlwind affair. I hope I can fulfill the level of confidence shown in me by the membership and I can continue the good work done by Zoe Barber over the last three or more years.

It has been an eventful year for me, leaving Caswell after 27 years, working under the 'banner' of a number of companies. The last being "Oclaro", who are kindly helping to sponsor the Technological Plasma Workshop being held in Manchester in January 2012. The same can be said of our IPSI Group, who, are not only helping to financially sponsor it, but will also have a large presence there, as it maps directly into our subject matter.

Being involved with the IPSI Committee way back, a lot has changed since, mainly in the administration area. However, this is true in most sectors and 'new eyes' on procedures can question if these are truly improvements and progress is taking place.

The committee has been working hard over the last year organizing, hosting and helping manage meetings. Our annual meetings have taken place and have been well supported. Details and reports on these can be found in this newsletter.

Supporting students to help attend these meetings is still part of our remit. Although procedures for this have changed, we still encourage attendance and participation.

Ideas are not the property of the Committee !

If anyone has any thoughts, ideas on topics or specific issues they wish to pursue, please let us know. We can co-opt you to work on them yourself, or you can pass the ideas over to any of the committee. Contact details of any committee members can be found in this newsletter, or find us through the IOP web site ( Activities – Divisions and Groups).

Please encourage your colleagues, friends and work mates to join the Group and get involved with the Group activities. The more we are, the more we can do

If you like what we're doing, tell your friends.  
If you don't, tell us.

Alan Webb  
(IPSI Chair)

## IPSI News & Events

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### **Advances in Photovoltaics 14th September 2011, Institute of Physics, London**

Organised through the Ion & Plasma Surface Interactions Group, this meeting was co-sponsored by the IOP Vacuum Group, the Energy Group, Thin Films & Surfaces, and Printing & Graphics Science

This was a very well attended, entertaining and informative day, with presentations that provided an overview of the field, intermixed with reports on some fascinating new technology. Martin Green, from the University of New South Wales, set the scene with an overview of current market trends, a summary of where the exploitation of PV technology has got to, and where we can expect it to go from here. In Australia, PV use has been encouraged by perhaps overgenerous feed-in tariffs, leading to a large uptake of domestic-based PV modules. Goals for uptake vary greatly from country to country, given variable climates, with an overall figure of about 12% PV power contribution in Europe by 2020. Although cost is very close to retail grid parity right now in some parts of the world, there's still some way off wholesale price. Consideration of power demand cycles are relevant here. For example, a plot of daily power demand illustrated the potential contribution from different technologies: here, PV could flatten out the (mid-day) peaks. In Japan there has been significant investment in hydro-storage technology to make use of the nuclear output (which has to be continuous), and this could usefully be applied to PV input to the grid, flattening out the daily PV input cycle.

The focus then moved to the technology, and the competition between '1st generation' Si-wafer based and '2nd generation' thin film technologies. Many have written off Si-wafer based devices for economic reasons, but this ignores the huge potential for cost reduction in Si-wafer fabrication. As the market becomes more competitive, Si-wafer manufacturers are developing new, cheaper products based upon 'quasi-monocrystalline' Si ingots, which are being produced in larger and larger sizes. It was also interesting to see the advance in achievable efficiencies and cost reduction based upon the same basic Si p/n junction 'black cell' which first emerged in 1974. Past improvements have been on passivation, rear contacts, and surface texture developments, and immediate future goals include finding alternatives for the role of silver, to reduce costs further. Light trapping technology came up several times during the day – here we learnt that optical thickness can be increased to about 40 or 50 times the geometric thickness of the cell, through optimized rear surface scattering.

Advantages of moving to thin film technology include less materials usage, and large manufacturing capabilities with integrated module fabrication, but also aesthetics and ruggedness. Chalcogenides and, further ahead, dye-sensitized and organic cells, offer great potential, as well as capabilities for flexible devices. There are many possible technologies for 3rd generation cells, and it's not clear which is the frontrunner. One example is stacked cells, with different band gaps, in order to access the whole spectrum. Current work at UNSW includes stacked Si-based technology, with band gap manipulation using quantum confinement and optimization of stacked junction growth. Another approach they're working on is the development of hot carrier cells, in which slower thermal relaxation at the band edge is controlled by manipulation of the lattice's phononic properties.

Kurt Barth of Abound Solar described the transfer of a ~15 year University research project at Colorado State University through to the production line. The product consists of rugged CdTe PV modules, now being fabricated on a commercial scale. A unique encapsulation design, with an edge seal enclosing internal dessicators, gives impressive long term performance. At all stages of development manufacturability has been a key driver. Further expansion is taking place, and manufacturing costs are dropping as annual production increases. This is a great example of a really fast ramp from concept to production line, with potential for continued improvements.

Stuart Irvine (Optic Technium/Glyndwr University) also discussed the commercial drivers of cost reduction and improved capabilities. Thin film technology is relatively new, so is only now growing in maturity, with high volume manufacture leading to economies of scale. Materials challenges include the need for energy conversion efficiency improvement; reduction in quantity of costly semiconductor material; use of lower cost materials; and cheaper, lower energy processing methods, with high throughput. There are also issues of durability and product lifetime. Models of the costing breakdown, via the UK PV Supergen consortium, have illustrated that the relatively small materials component of total production costs doesn't justify switching to ultrathin films right now, but there's uncertainty about future materials prices, so that this situation may well change. Here it's important to remember that it's full materials utilization that must be considered (not just the quantity of material in the final device), and also to introduce the impact of improved cell efficiency. The bottom line is that efficiency must improve, but not at the expense of increased materials costs. Stuart also discussed advances in cell technology. Efficiency is monitored as a function of thickness: how thin can films be, whilst maintaining properties? Micro-Light Beam Induced Current mapping nicely illustrates uniformity and the presence of pin-holes, with different wavelengths (blue versus infra-red) showing up different issues. Current work includes enhancing absorption with light capture through scattering,

optimization of back reflectors, and the addition of super-absorber material to replace CdTe.

Cigang Xu, of Oxford Instruments, reported on a European-funded project on the development of Al<sub>2</sub>O<sub>3</sub> deposition for the rear side of cells, using Plasma Enhanced Chemical Vapour Deposition. This process has great potential for precise growth control. Ultimately, it's necessary to find an appropriate balance between growth rates, precursor usage, uniformity, and film properties.

We learnt about PV-related products and research at Sharp Laboratories from Matthias Kauer. PV is a key technology for Sharp, representing a growing fraction of product sales based on both Si and thin film technologies. Their plant in Wrexham, UK produces 500 MW per annum (crystalline Si), and Si thin film cell manufacture is being set up in Italy. In Sakai, Japan, thin film solar cell fabrication is going on alongside a major LCD facility where there are economies of scale, and overlap in the use of glass supplies. Sharp's R&D takes place in Oxford, with a range of areas and products. An example is proof of concept of a novel nanostructured thin film Si solar cell, using a very high aspect ratio light trapping 'moth-eye' surface as a substrate for subsequent film growth (~1.5 micron pillars, with ~ 0.5 micron spacing). Another interest is in multi-junction solar cells, based on a stack of lattice matched III-V materials, currently being fabricated by MBE.

Sam Stranks, from Oxford University, described the development of a PV composite 'blend' based on single-walled carbon-nanotubes (~1 nm diameter, 1 micron long) wrapped in a single layer of polymer (P3HT), and dispersed in a matrix. Time resolved Photoluminescence studies are being used to characterize the structures. We also heard about work on cost and efficiency gains through fabrication studies at Loughborough, including optimization of groove shape for buried contacts by laser ablation (for concentrator PV devices). Coherence Correlation Interferometry is a fast, large area method that is used for characterization. The requirement for a fast, cheap, in-line method for surface scattering studies was illustrated by work at the Laboratoire de Physique des Interfaces et Couches Minces, Palaiseau. They are using Mueller Polarimetry for monitoring surface texture optimization to control light management in devices.

Finally, Ralph Gottschalg (Loughborough University) gave an entertaining talk on the problems of testing cells and modules to be able to make true comparisons and give trustworthy data. Although people may assume that testing by placing two cells alongside each other will give a true comparison, this is not the case, for all sorts of reasons (including ground reflection, wind speed, and pigeons!). And there are serious issues with reverting to 'laboratory conditions', simply because they don't represent the conditions in the field. Ralph described the outcomes of round-robin tests in a series of European laboratories. The description of the current attempts to develop International standards, requiring standard conditions,

standardised data for module behaviour, agreed methods for modeling energy yield, and standardized reporting, raised many smiles.

As if all this information were not enough, there was a lively and varied poster show to take in as well! A total of 17 presentations illustrated fabrication, structure, characterization, and modeling of PV cells and devices, as well as some novel applications.

## **Plasmas, Surfaces and Thin Films 8th June 2011, Institute of Physics, London**

The annual IPSI Group £50 student poster prize was awarded at the Plasmas Surfaces & Thin Films meeting, on June 8th. The judges awarded the prize for a poster from the Manchester Metropolitan University, entitled "Crystallisation behaviour of Cr<sub>2</sub>AlC MAX phase thin films". This poster had two student presenters: Maud Maillebauu and Laure Vergez.

## **The 14th European Conference on Applications of Surface and Interface Analysis (ECASIA) 4th-9th September 2011, Cardiff**

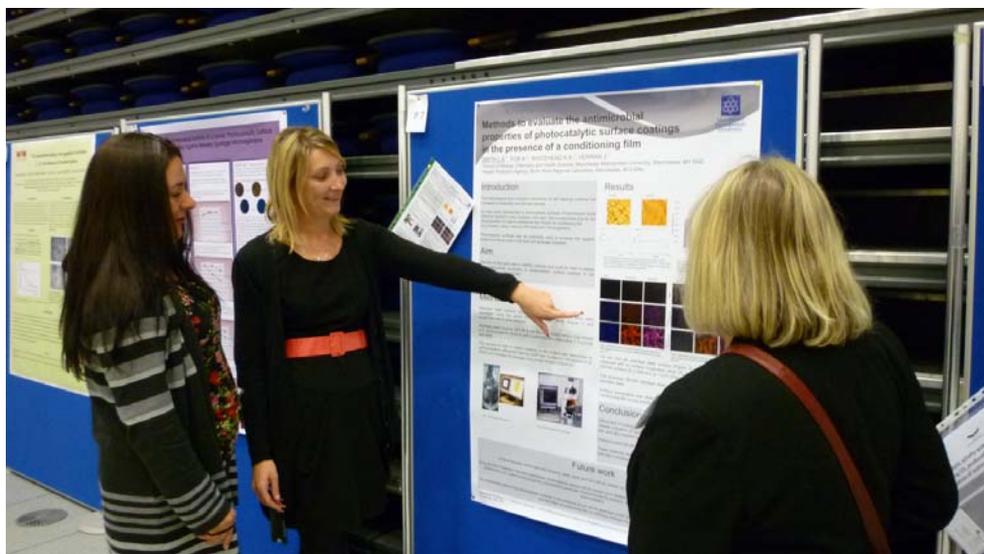
This biannual conference came to the UK for the first time, chaired by Albert Carley of the Cardiff University Chemistry Department. Three parallel oral presentation sessions ran throughout the week plus poster sessions in the historical Cardiff City Hall attended by over 300 registrants from Europe and the rest of the world. Two short courses ran in parallel to the conference, one on XPS/ESCA and Data Processing and the other on Materials Surface Micro-characterization and Analysis. The involvement by industry was significant with a total of 20 exhibitor booths. Despite wet and windy conditions, the spirits of the delegates were largely undampened thanks to high quality scientific presentations, trips to local sites of interest such as the Penderyn Whisky Distillery and the rousing contribution of The Millenium Stadium Male Voice Choir at the conference dinner.

## **Photocatalytic and Superhydrophilic Surfaces Workshop (PSS2011), 12th September 2011 Manchester Metropolitan University**

This inaugural workshop was held at the Manchester Metropolitan University on 12th September 2011. It comprised a one-day event incorporating four sessions of invited and contributed oral presentations and posters covering the production, characterisation and applications of photocatalytic and superhydrophilic materials. Guest speakers included experts from the medical and construction sectors, as

well as practitioners of photocatalyst scientific techniques. Fifty-two delegates from ten European countries attended, and the response and feedback generated fully supports the continuation of this event in future years. Particular praise was given for the networking opportunities provided by bringing together a range of experts from sectors that do not regularly interact.

Support provided by the Ion and Plasma Surface Interactions (IPSI) group of the Institute of physics enabled the workshop to be delivered at a very competitive cost – particularly for student delegates; a key factor in establishing a new event in the scientific calendar. The organising committee of PSS2011 extends its gratitude to the IPSI group committee for this generous support.



Delegates attending PSS2011 were asked: “What was the most beneficial outcome of your attendance?” Here are some of their responses:

*‘discovering the UK community working in photocatalysis’*

*‘more knowledge of antimicrobial tests/methods and an opportunity to collaborate’*

*‘good networking opportunity’*

*‘improved my knowledge of sputtered coatings and deposition techniques’*

## British Vacuum Council Rewards Excellence!

The British Vacuum Council (BVC; <http://www.british-vacuum-council.org.uk/>) represents the UK and Ireland in the scientific and educational activities of UNESCO's International Union of Vacuum Science, Technique and Applications (IUVSTA; <http://www.iuvsta.org>). Annually, the BVC rewards excellence in its broad constituency through two prizes; the BVC Senior Prize and John Yarwood Memorial Medal for established researchers and the C. R. Burch Prize and BVC Medal for early career researchers. Both of these awards reflect distinguished contributions to scientific research from a scientist from the UK and Ireland in the fields of vacuum science, surface science, thin films or any related topic in which vacuum science and engineering play an important role.

The 2011 Senior Prize and John Yarwood Memorial Medal was awarded to Professor Peter Weightman (University of Liverpool) and was presented at ECASIA 14 in Cardiff in September. The C. R. Burch Medal Prize and BVC Medal for 2011 was shared by Dr. Felicia Green (National Physical Laboratory) and Dr. Peter Carrington (Lancaster University). Dr. Carrington received his award from the BVC Chair, Professor Martin McCoustra, at the UK Semiconductor Conference in Sheffield in July and Dr. Green received her award at the September meeting of the British Mass Spectrometry Society in Cardiff.

As of September 1st 2011, nominations are sought for both the BVC prizes for 2012. Details of the nomination procedure are to be found under the relevant heading on the BVC website. All nominations must be submitted by 31st January 2012.

## CDT-Lite project

EPSRC has funded a new multidisciplinary Centre for Doctoral Training on the Application of Next Generation of Accelerators. This project will recruit 10 doctoral researchers per annum to research in this field and is shared between the University of Surrey, Strathclyde, Huddersfield and Queens University Belfast. For more information visit this link: <http://ngacdt.ac.uk/> or if you are interested in finding out more please contact Prof. Karen Kirkby (k.kirkby@surrey.ac.uk).

## Forthcoming Meetings

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### Technology Plasma Workshop (TPW): Manchester, UK, 5-6 January 2012

The next meeting of the UK Technology Plasma Workshop will be held on January 5-6, 2012, hosted by the University of Manchester. The website [www.tpw-uk.org](http://www.tpw-uk.org) is now open for registration, payment and abstract submission. Please note the deadline for abstract submission was November 28, 2011.

**International Workshop on Beyond Molecular Dynamics: Long Time Atomic-Scale Simulations: Dresden, Germany, 26 - 29 March 2012**

Molecular Dynamics (MD) is an extremely powerful tool for investigation of many phenomena including chemical reactions, protein folding, thin film growth and irradiation effects. It can be used with both classical empirical potentials to model the atomic interactions or through the direct use of ab-initio methods to determine the interatomic forces. With ever increasing computer power spatially large systems can be studied but the extension of time scales is much more difficult since kinetic processes such as chemical reactions and diffusion can take place over times many orders of magnitude greater than the numerical integration time step in an MD simulation. In a kinetic process a system can be trapped in a local minimum energy configuration for a period much longer than that for the transition to another metastable state. Thus the problem of extending time scales requires methods which go beyond MD. These algorithms explore the potential energy surfaces, determine the saddle points, surrounding a minimum energy site and the minimum energy and maximum flux paths and the relative probabilities for transitions to the next state of the system. The problem is not just to find an algorithm but to be able to develop efficient computational procedures to apply them to real life problems. Many such methods have been proposed including kinetic Monte Carlo, milestoning, temperature accelerated dynamics, metadynamics but so far no preferred best method has emerged. In addition many of the implemented algorithms need to be more rigorously justified.

The purpose of this workshop is to bring together scientists with different backgrounds, biologists, physicists, materials scientists, chemists, mathematicians and computer scientists to discuss recent developments in both the theory and algorithms behind long time scale dynamics techniques and also the application of new techniques to problems of topical interest. This workshop intends to provide a stimulating environment both for the exchange of ideas among established researchers and also to provide a forum where Ph.D. students entering into the field can learn from the world experts.

<http://www.pks.mpg.de/~bemod12/>

**International Conference on Nuclear Microprobe Technology & Applications  
Lisbon, Portugal, 22-27 July 2012**

Since the first edition in 1988, ICNMTA has established itself to become a premier conference in microbeam technology. The conference fosters the gathering of scientists from all over the world to exchange ideas, share new knowledge and technical know-how in the relevant fields.

The 13th ICNMTA includes plenary sessions, keynote lectures and several specialized sessions on different topics related to microbeam optics and instrumentation, imaging and tomography, cell irradiation and proton beam writing with relevant applications in Materials Science, Microelectronics, Biology, Biomedicine, Earth & Environment Sciences, and Archaeometry. The conference also includes tutorial talks, poster sessions and the Proton Beam Writing workshop, which will be held at the conference venue. <http://www.icnmta2012.itn.pt/index.html>

### **MeV-SIMS Technical meeting, Dubrovnik, Croatia, 21-25 May 2012**

This meeting will be held at the Inter-University Centre Dubrovnik (IUC), see link: <http://www.iuc.hr/>. Look for updates on the SPIRIT website: <http://www.spirit-ion.eu/Start.html>

## **IPSI Student Funding**

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The IPSI committee has awarded several bursaries to students over the past year. Here are reports written by the students detailing how they benefited from this funding.

### **Materials Research Society (MRS) Spring Meeting and Exhibit, April 25 - 29, 2011 Moscone West Convention Center - San Francisco, California**

Sabrina Blackwell from the Department of Mathematical Sciences, Loughborough University presented a poster "Modelling the Sputter Deposition of Thin Film Photovoltaics using Long Time Scale Dynamics Techniques" and gave the following comments about her experience:

The session on plasma-based synthesis of TCOs and oxides for emerging technologies was very interesting, and this is the session in which I presented. My presentation went very well, generating interest in the audience of 50 people. There were 50 sessions running in parallel so I made sure to pick before hand which talks were interesting to myself, I particularly stuck in the symposium for Complex Oxide Materials for Emerging Energy Technologies. I have benefitted a lot from the conference, in both my subject knowledge and in my networking skills and confidence. I made many contacts during the conference some of which are interested in collaboration or who want to cite some of my work, so I can say that the week was very successful.

**ANZFSS 20th International Symposium on the Forensic Sciences, 5th-9th September 2010, Sydney, Australia**

Nick Bright of the University of Surrey, awarded £250 by IPSI, had the following to say about attending the international symposium:

From the 5th-9th September 2010, I was lucky enough to be able to attend the ANZFSS 20th International Symposium on the Forensic Sciences. I had been selected to give an oral presentation on my research titled "Forensic Fingerprint Analysis Using Particle Accelerators". I believe my talk was well attended not only by specialists in the field but from people with a general interest in fingerprinting. The talk went well and I was contacted after the symposium by the Head of the Bordeaux Gendarmerie asking for more information on my research.

The highlight of the symposium was a talk from an Australian forensic scientist who had been in a 10 year "saga" about a case he was involved with and how he handled the investigation. It was interesting because the speaker was talking about how he felt as a person, and it made the role of a forensic scientist seem a bit more real.

The main benefits I think I have obtained from attending the symposium are that I have now international experience of presenting research to a large audience, and that from observing other people present their research I can see what is good and what is bad in terms of presenting style.

The symposium was not that specialised in that it covered the whole of forensic science, this made it accessible to all people interested in forensic science, not just those who work in the field. It was a great trip and I would love to go back in 2 years time.

**Controlled Release Society Annual Meeting, 10th – 14th July 2010, Portland, USA**

Ali Rafati of the University of Nottingham was awarded £175 for travel and had following to report back to IPSI:

The Controlled Release Society (CRS) conference was a useful experience both in terms of networking and content. I certainly consider it a success, the program was broad and there was invariably a talk of interest on in the six simultaneous meeting rooms. The plenary speakers were fascinating and provided a broad insight into the field and the direction in which it is going. The conference broadened my horizons with respects to the type of drug delivery systems I could apply biophysical analysis to in order to rationalise the in vivo properties of.

The poster I presented had considerable interest as the analytical techniques used in my work are applicable for much of the work done by members of the controlled release field. The work I presented was acknowledged with a request for the work to be published in the CRS newsletter (a monthly ~ 30 page publication for CRS members highlighting some of the latest work in the field). The technique of Confocal anti-Stokes Raman scattering was of interest to me considering the benefit to the spatial resolution for non-invasive analysis of samples such as microspheres I have analysed previously.

There was a few young scientist sessions which were of interest, the most interesting presented by an Elsevier executive publisher and the editor of the journal of controlled release which I attach with this report as the tips are something which young scientists may find of interest. (While most applicable for the JCR some of the format will be of use for other journals).

**Ion Implantation Technology Conference, 6th-11th June 2010, University of Kyoto, Japan**

Luke Antwis of the Surrey Ion Beam Centre at the University of Surrey had the following to report about his experience:

The Ion Implantation Technology (IIT) conference is a bi-annual conference that meets to discuss current and future trends in ion implantation. It is considered to be the foremost conference for this particular area of research and is the main conference widely attended and supported by industry, who view it as an opportunity to showcase their technological developments and research. It also has a significant attendance from academia and pure research institutions such as IMEC.

Ion implantation is the technology process that is common to all CMOS (complimentary metal-oxide-semiconductor) based electrical devices, a technology which in turn accounts for the vast majority of microchip devices. Due to its heavy use over the last four decades, the implant process is an extremely mature technology. However, silicon microchip technology is rapidly approaching a plateau in terms of the capabilities of the devices, and so the implant industry is starting to look towards other applications for the process. Therefore, a significant theme of this conference was emerging and future implant requirements, such as biomedical applications and so called large area electronics, which includes photovoltaics.

As a result of this, and because of my research work into future photovoltaic materials, I felt it essential to meet with industrial and academic leaders within this field in order to discuss my work and gain a feel for the potential relevance of ion implantation with regard to future photovoltaic technologies. The conference provided the perfect opportunity to shake hands with the people who would be making the key decisions with regard to the direction and technologies that the industry will embrace over the coming years, and it gave me a chance to promote the work that I have undertaken over the last year with a poster presentation. This enabled me to get valuable feedback on the quality and relevance of the work, as well as suggestions about how to take the research forward and develop it into a viable technology. The feedback received was both useful and encouraging, and there was particular interest in my work from one company who are looking to harness a new technology in order to relieve their dependence on the CMOS market. The comments given to me on the high quality of the poster were also extremely gratifying.

It was also good to be able to put faces to the names of authors whose papers I have been reading over the last year, and fill in the inevitable gaps in my knowledge, and acquaint myself with people with whom I already had a relationship, but rarely get to spend time with. The conference lived up to its billing as the premier meeting of ion implantation experts, and was extremely useful to myself from a technical and personal point of view, and I consider my visit a great success.

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The Research Student Conference Fund can provide financial support to research student members to attend international conferences and major national meetings. Apply for up to £250 during the course of your PhD. If you would like to apply, please visit:

[http://www.iop.org/about/grants/research\\_student/page\\_38808.html](http://www.iop.org/about/grants/research_student/page_38808.html)

## The Committee

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**Chairman**

Alan Webb                      The Open University, [Alan.Webb@open.ac.uk](mailto:Alan.Webb@open.ac.uk)

**Hon. Secretary**

Brian Jones                    University of Surrey, [b.jones@surrey.ac.uk](mailto:b.jones@surrey.ac.uk)

**Treasurer**

Adrian Leyland                University of Sheffield, [A.Leyland@sheffield.ac.uk](mailto:A.Leyland@sheffield.ac.uk)

Zoe Barber                      University of Cambridge, [zb10@cam.ac.uk](mailto:zb10@cam.ac.uk)  
James Walsh                    University of Liverpool, [J.L.Walsh@liverpool.ac.uk](mailto:J.L.Walsh@liverpool.ac.uk)  
Philip Martin                   University of Manchester, [Philip.Martin@manchester.ac.uk](mailto:Philip.Martin@manchester.ac.uk)  
Gregory Clarke                Pilkington NSG, [Gregory.Clarke@nsg.com](mailto:Gregory.Clarke@nsg.com)  
Graham Cooke                Hiden Analytical, [gcooke@hiden.co.uk](mailto:gcooke@hiden.co.uk)  
Adam Brierley                 Brinell Vision Ltd., [adam.brierley@brinellvision.com](mailto:adam.brierley@brinellvision.com)  
Roger Smith                    Loughborough University, [R.Smith@lboro.ac.uk](mailto:R.Smith@lboro.ac.uk)  
Glen West                      Manchester Metropolitan University, [G.West@mmu.ac.uk](mailto:G.West@mmu.ac.uk)  
Ashley Knowles                Yorkshire Photonic Technology Ltd.,  
[ashley.knowles@yorkphotonics.com](mailto:ashley.knowles@yorkphotonics.com)

**Ideas for future meetings:** The Group welcomes ideas from members for topics for future events, including conferences, meetings and workshops. Please contact the Chairman or Secretary.

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This newsletter is also available on the web and in larger print sizes

The contents of this newsletter do not necessarily represent the views or policies of the Institute of Physics, except where explicitly stated.

The Institute of Physics, 76 Portland Place, W1B 1NT, UK.

Tel: 020 7470 4800

Fax: 020 7470 4848