IOP | Institute of Physics
Materials and Characterisation Group

NEWSLETTER November 2014

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Scenes from the "Preserving our History: Cultural Heritage and the Science behind it" conference held at the Mary Rose Museum, Portsmouth, Sept 2014.

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Message from the Editor

Welcome to the 2014 edition of the Materials and Characterisation Group newsletter. 2014 has been a busy year for the group with conferences spanning a range of themes being organised or supported and you will find reports of these on pages 7-14.

As you'll see on the back cover, we have also now launched a group blog as well as the newsletter which we intend to use for more regular updates throughout the year, so bookmark and keep checking it periodically. If you have any contributions for the group blog, please do email blog editor Melvin Vopson at melvin.vopson@port.ac.uk

As always, if you have any comments, or suggestions for content or features, please feel free to drop me a line at c.dancer@warwick.ac.uk

Claire Dancer
Newsletter Editor

This newsletter is also available on the web and in larger print sizes: see http://mc.iop.org

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Chair's report

Dear M&C Group members

Time has flown again this year and another Group newsletter is now due. Firstly I would like to thank Alison Crossley (Treasurer) and Richard Morris (Secretary) along with the other committee members for their continuing support. In particular Claire Dancer, who has put together the Group's newsletter again. It is a privilege and pleasure to chair this committee, who all willingly give their time to further physics of Materials and Characterisation.

As we began in last years' newsletter, we are keen to highlight the potential for IOP membership and the scope it offers for personal and professional development. We only cover one area per newsletter so do investigate the IOP website as well. One such area that hopefully all PhD students are familiar with is the Research Student Conference Fund. Although the applications are submitted centrally, any that are applicable to our Group are sent to the Group Officer's for consideration and we try very hard not to turn any student down, even if we can't give the full amount at times. So if you're a student presenting a paper or poster, please do apply.

Several successful events have and will run this year, events the Group has organised or contributed to in some way, and the reports are included in the following pages. There are also several events already planned for the forthcoming year, further details (and any new additions) can be found through the Group's calendar as they come online.

Best wishes

Jon Painter

What Can the IOP Do For You? Getting Chartered.

One of the many reasons why you may be a member of the Institute of Physics is the opportunity to gain professional designations by becoming a chartered Physicist (CPhys) or Engineer (CEng).

CPhys can only be gained through the Institute of Physics and is awarded to those who work in a physics-related scientific field. In addition to the completed application form, you must submit:

- Details of your two supporters (one of whom must be a Chartered Physicist) and a covering letter explaining the choice of supporters, if they are not IOP members.
- Current CV
- Notarised copies of your Degree certificates
- Organisational chart
- Professional review report

If you do not hold a Masters degree in Physics, but work in a clearly physics-related sector, you can still apply for CPhys although some extra documents are required:

- For those who hold an accredited Bachelor's degree in Physics (but not an accredited Masters) you will need to complete the Master's project equivalence report.
- If your degree is not accredited by the IOP, in addition to the Master's project equivalence report you must also complete the "Core of Physics" section of the application form, which confirms that you have a baseline level of physics knowledge achieved through your education and professional experience.

CEng is however awarded by a number of bodies including the IOP and recognises experience in the engineering-related sectors. Similar documents are required for CEng as for CPhys although the focus in this case should be on your experience in an engineering-related sector and your supporters must be chartered engineers. If you do not hold an accredited MEng degree, a technical report is required.

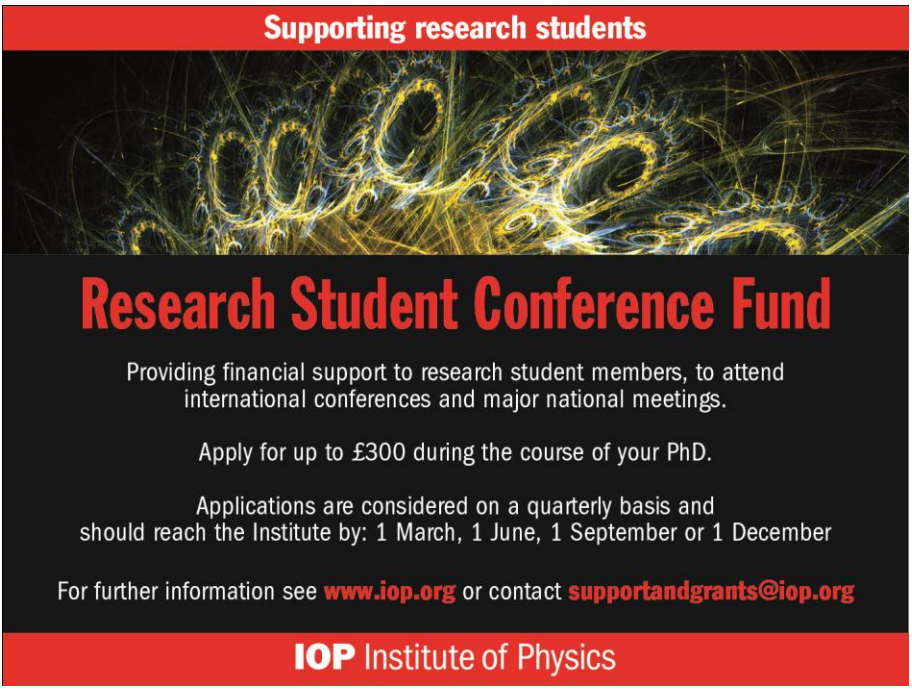
Once your application has been reviewed you will be asked to attend an interview, and you should receive the result of your application within 4 weeks of your interview.

Getting Chartered Workshops

If you would like to find out more about the process and benefits of becoming chartered, you may be interested in attending one of the IOP's "Getting Chartered" workshops. Several of these workshops will be held during the remainder of 2014 – for more information on locations and how to book please visit http://www.iop.org/membership/prof-dev/tools/workshops/page_38316.html or email CPD@iop.org

IOP Research Student Conference Fund

Student members can obtain funding from the IOP Materials and Characterisation Group to attend a meeting or conference. Each year we have several Research Student Conference Fund bursaries worth up to £300 to give away. The eligibility criteria and application form are available at http://www.iop.org/about/grants/



As part of being awarded a bursary you must write a short report on your experience at the conference. Selected reports will then be published in this group newsletter.

On the next page you will find a report from a recent Research Student Conference Fund awardee.

Materials Science & Technology Conference, Montréal, Canada

Report: Giorgio Schileo, Sheffield Hallam University

Thanks to a travel bursary awarded to me by the **IOP - Materials and Characterisation Group**, I was able to attend the Materials Science & Technology conference in Montréal 2014. It has been a very important experience in my academic studies, both for the high level of the talks and for the fruitful interactions with some speakers and other students both after the talks and at the poster session.

I found particularly interesting the talks by Jim Scott and Marty Gregg about a new room temperature multiferroic (lead iron tantalate - lead zirconate titanate), and the session about the photovoltaic application of multiferroics. In addition, I followed with interest the talks by Ram Katiyar and Juan Nino.

One of the conference organizers made available for one day a number of professionals to discuss career paths over lunch, paired with another student. I found this opportunity extremely useful because it provided an alternative perspective on the research work undertaken in an academic environment when it has to be developed for a commercial application.

By attending the conference I had the opportunity to talk directly to the authors and co-authors of important papers I consulted for my research. After presenting my research at the poster session to several attendees, I was also asked to participate to a future conference in the US and to collaborate with a group based in Canada to compare the properties of my materials by preparing them by PLD into thin films. In general I established new academic and professional contacts and gained useful new ideas and insights for my own research, therefore I am extremely satisfied with my personal outcome for this conference, which exceeded my expectations.

Overall I think the conference was successful: the average quality of the talks was quite high; Montréal is well connected by plane and the public transport is highly efficient; the venues (conference rooms and facilities) were outstanding. However, there were some negative points too. I noticed that three speakers did not show up nor send a substitute, which was a bit disappointing, and on the last day (the fourth) the average attendance was significantly low: perhaps three days should be considered as the maximum duration for a conference.

Finally, I would recommend students to apply for student monitors to the sessions they would like to attend, if this possibility is offered in other conferences, as it helps to "break the ice" with speakers and to give an idea about how to prepare effectively for an oral presentation.

Reports on Conferences Supported by the Group

10th Photovoltaic Science Application and Technology Conference

Report: Prof. H S Reehal (London South Bank University)

The PVSAT-10 conference was organised by the Solar Energy Society, UK. The 6 sponsors included the Materials and Characterisation Group of the IOP. PVSAT continues to be the premier annual event for the presentation and dissemination of research in photovoltaics in the UK. This year's conference was held at Loughborough University from Wednesday 23rd April to Friday 25th April. It was well attended with ~120 delegates and several exhibitors. Twenty postgraduate student bursaries covering the conference registration fee were made available by the EPSRC Supergen SuperSolar Hub.

The conference was opened by the conference chair, Dr Tim Bruton, and included a welcome address from Dame Mary Archer, President of the Solar Energy Society. The technical programme which followed was wide ranging and organised into 9 oral sessions containing 40 oral presentations which included 8 invited talks. There were 37 poster presentations delivered in 2 poster sessions.

In the invited talks Prof Ralph Gottschalg (Loughborough University) discussed the long term performance of photovoltaics.

This was followed by Dr David Jordan (University of New South Wales) with an interesting account of developing and transferring emerging PV technology from university to industry.

Dr Finlay Colville (Solarbuzz) outlined the factors driving the PV industry to a likely 50 GW demand in 2014. The global market was 38 GW in 2013. Multi-crystalline Si is currently the dominant technology whilst thin film PV remains challenging.

Dr Muriel Watt (IT Power Australia and UNSW) described the development of the Australian PV market and implications for the established electricity sector.

Transparent barrier materials for flexible thin film PV and other large area devices was the subject of the talk by Dr Alf Smith (Centre for Process Innovation).

Dr Gang Xiong (First Solar) discussed the status of the development of CdTe solar cells and modules. His company is using single crystal CdTe as a platform to identify the factors limiting performance with a goal of a 25% efficient cell.

In an interesting talk, Dr Magnus Heurlin (Lund University) described the progress in III-V nanowire photovoltaics where efficiencies approaching 14% have been demonstrated in axial devices.

The final invited talk was by Dr Jim Sites (Colorado State University) who talked about various approaches to increase efficiency in CdTe devices.

The other talks and posters were of high quality and covered a wide range of topics from solar cell materials and devices, modelling, fabrication, PV systems performance and PV deployment.

A welcome reception and dinner was held at Burleigh Court, Loughborough University on the evening of the 23rd April. This was followed by the main conference dinner and awards presentation on the 24th April at Holywell Park, Loughborough University. The awards presented were as follows:

Student best paper prize (sponsored by the IOP Materials and Characterisation Group)

W J Mughal, H A Mughal, A G Laffoley, D M Bagnall, N E B Cowern, S Simdyankin and S A Boden, University of Southampton (lead author), “A high-efficiency, low cost IBC cell using doped laser cut back-side contacts”.
The award of £100 in book tokens was presented by Prof H Reehal on behalf of the IOP.

Best paper prize
J Dimmock, S Day, K Smith, J Heffernan, M Kauer, Sharp Laboratories, “Hot carrier solar cells: efficiency limits and realisation”.

Best poster prize
D Kishore Kumar, M-H Hsu, A Ivaturi, S Senthilarasu, S A Agarkar, S B Ogale, H M Upadhyaya, Heriot-Watt University, “High efficiency room temperature binder free TiO_2 paste for flexible dye sensitized solar cells”.

During the awards dinner Dr Tim Bruton announced that he would be stepping down as the conference chair and that Dr Nigel Mason (ex BP Solar) would be taking over this role. Dr Bruton was warmly thanked by Prof Michael Hutchins (UK-ISES) and Dame Mary Archer for his sterling service over the past 10 years.

The conference was followed by a technical tour of the CREST laboratories for interested parties. The 11th Photovoltaic Science, Applications and Technology Conference (PVSAT-11) will take place at Leeds University from 15-17 April 2015. Details will be available at http://www.pvsat.org.uk/

Preserving our History: Cultural Heritage and the Science behind it

Report: Dr Alison Crossley (Department of Materials, University of Oxford)

This one day event organised by the Materials and Characterisation Group, IOP and sponsored by the XMaS mid-range facility and EPSRC and the Mary Rose Trust, was held at the Mary Rose Museum on 3rd September in Portsmouth and followed on from a previous similarly themed meeting in 2011.

Following a welcome from our hosts at the Museum, Des Barker, formerly from the University of Portsmouth, kicked off the proceeding by sharing his knowledge and experience on preserving many ferrous artefacts recovered from marine sites in the Solent region. Removal of the chloride ions in the layers of rust covering the artefact without altering the shape of the artefact and preventing any further corrosion while it is on display or in store is the aim of the conservator and Des gave us several examples of methods successfully used to achieve this. Traditional aqueous washing was used in the conservation of the first Royal Navy submarine, Holland 1. An electrolytic process was used for the First World War Gunboat, M33, and a Hydrogen Reduction method, which removes the chloride as a volatile gas, was used for the guns from the Mary Rose. Des and colleagues were able to take advantage of the many unused breweries in the Portsmouth region to house the specialised equipment needed for this process.

This was followed by a talk with the intriguing title “Heritage Smells” by Lorraine Gibson, University of Strathclyde, who described the main scientific and heritage objectives of the Heritage Smells interdisciplinary AHRC research project. Within this project new analytical and sampling methods have been developed to examine VOC emission profiles from polymers, paper and chemically treated objects. This allows conservators and keepers of collections to assess objects by their emission profile alone allowing them to gain some understanding of their objects without the need to touch them, and hence evaluate storage or display conditions for objects that will potentially degrade. Lorraine highlighted the ethical dilemma facing collection owners of the conflict between conservation of artefacts for future generations or allowing the public to experience them today.

Professor Mark Dowsett, University of Warwick, spoke about the use of synchrotron techniques for studying heritage metal corrosion and protection in real time with a preamble on the term 'non-destructive analysis.' Mark explained how the term “non-destructive” is widely misunderstood and showed how intense probes can damage heritage metal surfaces. Synchrotrons produce intense electromagnetic radiation from the infra-red to hard x-rays and can provide the probe for numerous analytical techniques, for example infra-red spectroscopies and x-ray diffraction. Analyses may be up to 10,000 times faster than any equivalent laboratory technique giving rise to the possibility of time-lapse studies on evolving systems, and fast acquisition of chemical maps, however careful

research on the effect of the probe on the sample must be undertaken in case the probe used is modifying the measurement during the experiment. The first results from a novel instrument, XEOM 1, which will be able to acquire micron resolution maps of stable and evolving surfaces in controlled environments by using high flux, low power density macro-beams were presented.

The morning session was concluded by Trevor Plant from IOP outreach showing how the Institute of Physics through its Stimulating Physics and other initiatives supports teachers and raises the profile of physics in schools, starting from two beliefs: First, that it is the cultural entitlement of all students to learn physics, taught by an accomplished teacher with expertise in the subject, until they can make an informed decision to take it no further. Secondly that the biggest single external influence on a learner's progress in, engagement with, understanding of and enjoyment of the subject is their teacher. It is essential; therefore, that there is a complete, professional, engaged and satisfied workforce that includes enough accomplished teachers with expertise in teaching physics.

However, because there is a shortage of specialist physics teachers across the country, too many pupils are being taught by non-specialists who have a poor grasp of the fundamentals of the subject and no desire to promote a culture of physics in the school and a love of physics in the pupils. The Stimulating Physics Network is one of the Institute of Physics' projects to address these problems. Trevor checked the audience were wide awake by challenging them to demonstrate their knowledge of forces.

Conference delegates at the Mary Rose Museum

The afternoon session started with a talk by Alick Leslie from Historic Scotland entitled "Look but don't touch: Non-destructive testing and its application to the conservation of Scotland's built heritage". Historic Scotland has over 300 buildings and structures in its care, and changes to weather conditions, combined with budgetary constraints, are posing increasing difficulties in devising efficient and effective maintenance schemes. Emphasis is being given to monitoring and

early repair or mitigation to avoid catastrophic deterioration to buildings and non-destructive testing has an increasing role in detection of issues with Scottish built heritage. Use of thermal cameras is well established as a powerful tool in detecting anomalies within buildings. This technique can now be combined with microwave moisture detection that can provide a semi-quantitative measurement of water content within a structure up to 0.8 m in thickness. In addition to distribution of water, a suite of techniques allows measurement of permeability, chemistry, pore distribution, etc., all of which can help in building conservation.

Laser scanning has long been used to construct 3D models of building facades, the quantity and precision of data produced allows a direct measure of the condition of building materials to be made, and research is underway to identify the potential of using the various scanning technologies from remotely piloted vehicles so that detailed condition surveys can be carried out without the need for scaffolding. While sampling is sometimes inevitable, the range of non-destructive analysis techniques has greatly improved our ability to maintain Scotland's valuable built heritage.

Perhaps the most eagerly awaited talk was saved till the last. Entitled "Engineering the past – A Tudor tale", it was presented by Nick Owen, a Sports and Exercise Biomechanist working in The Applied Sports Technology Exercise and Medicine Research Centre (A-STEM) in the College of Engineering at Swansea University. More used to working with elite athletes, Nick was initially contacted by Mark Jones from the Mary Rose Trust to apply his expertise to the study of the fairly complete skeletons of nearly 100 individuals recovered when Henry VIII's warship Mary Rose was raised from the sea bed in 1982, particularly with respect to the archers on the ship. Previous research, based on the effect of occupational activity on bones, did not fully consider the mechanics of using a medieval longbow. Nick's study used motion capture to estimate the 2-D external forces applied to the arms and shoulders when drawing a medieval long bow. He discovered that lower arms were subject to the greatest differential external loading. Since the radius transmits more force than the ulna pairs of radii (n=20) were chosen for dimensional comparison. Radii were scanned using a laser scanner and comparisons were carried out on the virtual bones. The proximal and distal articulating surface areas showed the greatest bilateral differences, averages of 7.87% and 5.24% respectively, which is consistent with the external forces measured. Nick concluded his talk by showing the facial reconstruction of one archer. This is now on show in the museum and a perfect example of how an interdisciplinary scientific approach can truly bring history to life.

The day finished with the delegates having the opportunity to experience the newly opened Mary Rose Museum where the ship and the artefacts are displayed with those feeling strong enough testing their ability to draw a longbow. One attendee was overheard saying "This is the best one day meeting I have ever been to".

Recent Appointees in Materials Science

Report: Dr Claire Dancer (Warwick Manufacturing Group, University of Warwick)

After a break in 2013, the Recent Appointees in Materials Science (RAMS) conference was organized by Dr Valeska Ting (University of Bath) and Dr Adam Perriman (University of Bristol) at the University of Bath from 11th-12th September 2014. This unique conference brings together recently appointed lecturers and other early career academics in Materials Science, and with 54 attendees, RAMS 2014 was the largest to date.

The conference was split over two days and held in the new Chancellor's Building at the University of Bath. As delegates came from many research areas, and indeed departments, the range of topics covered was very diverse. On the first day talks were primarily in the category of "Inorganic" materials science, and from the very start the broad range of research areas represented was evident. Talks ranged from materials modelling to pure experimental research, and covered both fundamental and applied science. The technical sessions on Day 2 focused more on "Biomaterials" and again the range of approaches represented was evident. In the Biomaterials plenary Prof Hagan Bayley of the University of Oxford told us about his research on "Tissue-like materials from communicating droplet networks". Encompassing chemistry, biomaterials and engineering, his talk was extremely interesting to the delegates who came from both those backgrounds encompassed in these areas and more. This was followed by a session of contributed talks on Biomaterials covering topics from cryopreservation of cells to characterisation of pharmaceuticals.

Lively questioning following each talk indicated the interest of the audience in finding linkages between research topics, and the poster session and coffee breaks certainly gave everybody a good opportunity to ask any burning questions remaining. Following the poster session, delegates headed down the hill to the conference dinner which was held at the lovely location of the Bathwick Boathouse in the centre of Bath.

However, RAMS is primarily a networking opportunity for early career academics, and so just as important as the technical talks were the less research-focused sessions. On day 1 Prof Judith MacManus-Driscoll told us "How to Survive and Succeed as an Academic in Materials Science in the UK" – valuable advice for all present! Prof MacManus Driscoll's career has taken her back and fore across the Atlantic, with stints to Stanford and Los Alamos among others, and she is currently based at the University of Cambridge. Her advice to focus on research wherever possible, to get out and go to conferences, and her comments about the difficulties of managing a research group were all drawn from her own experience. This frank advice coupled with her obvious enthusiasm for her career and her research made for an excellent and informative talk. This was followed by the first

panel discussion where Judith was joined by Prof Hagan Bayley of the University of Oxford and Prof Chris Bowen of the University of Bath to talk about “Careers and Progression”, where even more valuable advice was forthcoming, particularly on ERC funding and dealing with administrative roles. It was great to get some inspiring words and useful advice from people who have been in the position where most of the delegates find themselves, and have lived to tell the tale!

The second day featured a panel discussion on “Funding and Publishing” as we were joined by Nigel Birch of EPSRC, James Hennessy of the Nature Publishing Group, and Fiona McKenzie of the Royal Society of Chemistry. After Nigel told us “How to Try to Get Money out of the EPSRC” (valuable information indeed!), James and Fiona told us about the publishing structure at their respective publishers. It was particularly interesting to hear directly from James and Fiona about the scope of their journals, and I’m sure I’m not the only delegate who as a result has a new option to consider for a future publication.

All in all, RAMS 2014 was informative, and a really great opportunity to get to know some fellow academics at an early career stage. If you are an early career academic in materials science, please consider coming along to RAMS 2015, which will be held at the University of Warwick in September 2015.

Left: Delegates of RAMS 2014 on the stairs of the Chancellor’s Building, University of Bath

The next RAMS conference at the University of Warwick in September 2015 will be organized by Dr Claire Dancer, Dr John Murphy and Dr Gemma-Louise Davies. Further details will be circulated via the IOP MC Group mailing list once available. If you would like to be added to the RAMS mailing list, please email c.dancer@warwick.ac.uk

Recent and Forthcoming Conferences supported by the IOP Materials and Characterisation Group

2014

5th Vacuum Symposium "Surface Modification and Analysis", Ricoh Arena, Coventry, 15th October 2014. www.vacuum-uk.org

Cultural Heritage Symposium at AVS 61, Baltimore USA, November 2014 https://www.avs.org/Meetings-Exhibits/AVS-International-Symposium-Exhibition/Information

2015

Applications of Novel Scintillators for Research and Industry (ANSRI 2015) O'Brien Centre for Science, University College Dublin, Ireland (12th - 14th January 2015) http://ssmr.ucd.ie/ansri2015/

10th Photovoltaic Science Application and Technology Conference (PVSAT-11) Leeds University 15-17 April 2015 http://www.pvsat.org.uk/

Materials Surfaces and Carbon Workshop co-sponsored by the Society of Chemical Industries and the Royal Society of Chemistry. Oxford (Spring 2015)

Recent Appointees in Materials Science (RAMS), University of Warwick (September 2015)

Reports on these meetings will be published in the next edition of the newsletter.

Updated information about conferences will be added to the group website http://mc.iop.org when available.

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Group Web Links

IOP Website

Our Group website address http://mc.iop.org is where you will find up to date information on the activities of the group including registration details for the conferences we sponsor and organise.

Materials and Characterisation Group Blog

We also have a Materials and Characterisation Group Blog which can be found at http://materials-characterisation-group-iop.blogspot.co.uk/ If you are interested in contributing to the Group Blog please contact the Blog Editor Dr Melvin Vopson at melvin.vopson@port.ac.uk