Scanning electron microscopy image of highly agglomerated barium titanate nanoparticles (Claire Dancer)

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Message from the Editor

Welcome to the February 2016 Institute of Physics Materials and Characterisation Group Newsletter. In this edition you'll find reports from the conferences we ran in the past year, an about Local Branches of the IOP, and information about forthcoming conferences.

If there's anything you'd like to get involved with, or if you’d like to propose a new conference, the contact details for group officers can be found on the back page – please get in touch with any ideas or proposals!

This will be my last newsletter as editor, as I am taking on the role of Group Secretary for the next few years, but I will be leaving the newsletter in the capable hands of Paul Binks, one of my colleagues on the committee who will introduce themselves next time. In the meantime, 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 / Group Secretary

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

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

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Chair’s report

Dear M&C Group members

Welcome to the latest newsletter from the Materials and Characterisation Group. The previous newsletter was produced towards the end of 2014 and the Group has organised and supported a diverse range of events in the interim period. Details of these workshops and meetings are included in this newsletter. We hope you find them informative as many of these events are annual or biannual.

As ever, the world of materials and characterisation continues apace and the need to keep up to date, exchange and collaborate with colleagues is vital to a healthy research base. Details of the planned events the Group is currently involved in supporting are listed towards the end of this newsletter. This list will no doubt grow as the year progresses so please keep checking the Group Calendar on the website. We are, as ever, open to suggestions for organising/supporting events.

The Group continues to support the applications of student bursaries, one of the benefits of IOP membership. But the IOP supports its members in various ways and the role of local branches is highlighted in this edition of the newsletter.

Finally there is space on the committee for any willing volunteers. Please get in touch with myself or any of the committee members for further information.

Best wishes

Jon Painter
What Can the IOP Do For You? Local Branches

As well as the subject-interest groups such as the Materials and Characterisation group, the Institute of Physics also has a number of local branches who run a wide variety of events which may be held much closer to where you live!

Branches are involved in a wide range of activities, including public engagement and outreach opportunities such as regional Big Bang fairs, as well as hosting programmes of talks and public lectures on a wide range of physics topics. Most of the larger branches hold talks at various locations around the region – for example the London and the South East branch holds events at IoP HQ in Portland Place, but also at Milton Keynes, University of Kent, AWE near Reading, and the University of Hertfordshire. The London and South East branch also hosts a Retired Member section which organises programmes of events such as talks and visits to interesting museums and other places such as the Rutherford Appleton Lab. This section is open to all retired IOP members from all branches, for more information see http://www.london.iop.org/remrs.

Branches also host the local heats of the “3 Minute Wonder” competition - a competition that challenges researchers in physics or a physics-related field to explain their work to the public in just three minutes. This challenging competition is open to anyone from academia or industry who has completed an undergraduate degree. For details of upcoming heats, see http://www.iop.org/activity/3-minute-wonder/page_60438.html.

If you’re keen to join or aren’t sure if you’re already a member of your local branch it’s easy to find out. Just log into your “My IOP” page from http://www.iop.org and click on “Change my branches”. You can check which branches you are affiliated to and add more branches if you wish. Currently there are branches in six English regions (South East, South West, Midlands, East, Yorkshire and North East, and North West), as well as branches based in Scotland, Ireland, Wales, and South Eastern USA). Several of the English regions are home to multiple branches, such as the North West region which has branches based in Manchester and District, Lancashire and Cumbria, and Merseyside.

Have a look at the Local Branches website to locate the branch nearest to you: http://www.iop.org/activity/branches/.

If you’re interested in setting up a branch in a country without an IOP branch, please email member.services@iop.org.
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/](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.
I attended the invited talk and tutorial from Professor Zhonglin Wang (Georgia Institute of Technology, USA), who is regarded as a pioneer in the field of nanogenerators and piezotronics, where he set out his vision for the motivation and development of self-power materials to transfer ‘wasted’ energy into electric energy. Prof. Wang, and his research groups’ presentations focused on triboelectric nanogenerators, that are not directly relevant to my research on lead-free piezoceramics have given me some interesting ideas that I intend to apply to my research due to the similar potential application as active sensors.

A unique feature of the of the MRS conferences is the tutorial sessions covering both technical and soft skill aspects of research. In addition to Prof Wang’s talk, I also attended the seminar ‘Essentials of getting your work published’ delivered by editors from three international journals (Journal of Materials Research, MRS Communications, and MRS Energy and Sustainability). I am currently in the process of finishing my first journal article, this seminar allows me to understand how to present my work in the most suitable manor. It also challenged the preconception regarding chasing a high impact factor, suggesting that choosing the most suitable journal based upon the results and discussion obtained rather than diluting the story with further results and potentially tentative discussion would give a better article and higher publication success rate.

A student mixer session offered me the opportunity to speak to a large number of students working in a number of countries (Korea, China, US, UK and Germany) studying a variety of subjects and research areas. The ability to discuss our work and share solutions to common problems with other students allowed me to understand and realise the breadth of global materials research and how my research fits into this body of work and it is relevant. The opportunity to network with other academics and students, allowed me to discuss possible new opportunities for my research applying their findings to my work, along with potential future collaborations. I took the opportunity to discuss what academics look for when recruiting a new post-doctoral research associate/fellow.

I found the opportunity to present and discuss my research at an international conference very rewarding. Most of the interest in my research fell in to three categories: i) the properties of the BCZT ceramics compared to other materials, ii) the application of Raman spectroscopy and iii) suggestions how I could further develop ideas.

In summary, I believe my attendance at this conference to be very successful. I am energised to apply my findings to both my research and my draft manuscript, as I embark on my remaining study.
Reports on Conferences Supported by the Group

Surface Modification and Analysis Seminar
*Ricoh Arena, Coventry, 15th October 2014*

**Report:** Dr Alison Crossley (University of Oxford)

This seminar was held as part of the 5th Vacuum Symposium UK at the Ricoh Arena Coventry and was a satellite meeting to the Vacuum EXPO 2014 exhibition. The organization was a collaborative effort between 5 IOP groups namely Ion and Plasma Surface Interactions, Nanoscale Physics and Technology, Thin Films, Surface and Vacuum and Materials and Characterisation and resulted in an excellent programme.

The first session, chaired by Dr Alison Crossley representing the Materials and Characterisation Group included a talk by Professor Steve Bull, Newcastle University (picture left). Steve discussed the importance of understanding structure / property relationships in sub-micron thin films to enable effective design, manufacture and durability. Examples included thermal insulation glass and electronic contacts.

Caterina Minelli from NPL gave the second talk which was concerned with the characterisation of coated nanoparticle including the accurate quantification of molecules attached to the surface of nanoparticles. Caterina showed that confidence in measurements could be improved by a multi method approach. The methods used which included XPS, DLS and UV/VIS spectroscopy gave encouragingly consistent results.

All the talks were of a very high standard and the meeting was enjoyed by over 60 attendees. The organisers are keen to repeat this successful collaborative venture next year.
This year the American Vacuum Society held its 61st meeting in Baltimore. This was the first year that a focus topic on the Conservation Science of Heritage Materials had been held at this meeting and the three half-day sessions were well attended, with only standing room available at times. The meeting had a good mix of scientific talks and case studies from conservators. The focus topic has had a large impact and articles have appeared as a result, including a piece in Inside Science: http://www.insidescience.org/content/science-and-art-meet-unveiling-mystery-and-cultural-tragedy/2316. A future focus topic session is planned for AVS 63 in 2016; this will be held at a similar time of year in Nashville.

A huge range of topics was covered by the speakers in three sessions, with speakers coming from both scientific and conservation backgrounds. Topics included historic documents and the conservation of paper, the analysis of pigments and paints, and conservation of metal and plastic artefacts.

This final session was followed by a lively discussion about the ethical and philosophical issues surrounding the use of destructive techniques, particularly those that are invisible to the naked eye. Analytical data can be obtained from defects, such as scratches, that are already present in the artefact, though this data may not be representative of the artefact as a whole. A key historical requirement of the conservation community is that testing methods are non-destructive, however it was questioned whether it is acceptable to sacrifice part of an object to preserve the whole. There are also cultural implications to consider, such as sacred artefacts which cannot undergo any imaging or analytical examination whatsoever.

The focus topic was completed by a tour of the conservation department of the Walters Art Museum and part of its collection.

Thanks go to Amy Walker of the University of Texas at Dallas and the organising committee for an extremely interesting and enjoyable conference.

Abstracts for all the talks may be found at http://www2.avs.org/symposium2014/Topic_CS_Sessions.html.
Workshop on the Applications of Novel Scintillators in Research and Industry (ANSRI)
University College Dublin, 12-14th January 2015

Report: Dr Oliver J. Roberts (University College Dublin)

A three day workshop on the development of novel inorganic and organic scintillators for various applications in research and industry, was hosted by University College Dublin from the 12th-14th of January 2015. The event was jointly sponsored by the IoP nuclear physics, nuclear industry, instrument science and technology, and materials and characterisation groups, as well as Science Foundation Ireland (SFI), ORTEC and SCIONIX. The agenda and most of the presentations can be found here, on the ANRSI workshop website. The speakers included representatives from many international industries, research laboratories and academic institutions.

The packed, three day schedule included: the development and characterisation of novel inorganic halide, glass-ceramic and plastic scintillators; applications of novel scintillators in a wide variety of fields, such as nuclear physics, medicine, gamma-ray astronomy and defence/security; and an IoP Ireland sponsored public talk one evening by Professor Luigi Piro on the newly approved €1 billion ESA space mission ATHENA.

An early career prize sponsored by ORTEC was also held during the workshop for the best contribution. The first place prize was awarded to Dr. Cristina Nita from the University of Brighton and IFIN-HH, for her talk on “Lifetime measurements of nuclear excited states using a mixed array of HPGe and LaBr3(Ce) detectors.” Two runner-up prizes were also awarded to Aleksandar Gostojic (CSNSM Orsay, France) and Barbara Wasilewska (IFJ PAN, Poland).

The event was attended by around 70 people from many different industries and scientific communities. The workshop was very successful in its primary goal of uniting many different scientists and industries together for the first time, with the aim of forming new collaborations for future research in the scintillator field. The positive feedback generated by this small international workshop attests to its success, and will likely lead to many future scientific exchanges between its participants for years to come.
Hosted and underwritten by The Solar Energy Society (UK), this was the 11th annual conference in the PVSAT series. The meeting attracted over 80 delegates keen to hear the scientific presentations given by the 8 guest and 30 contributory speakers and the 18 poster presentations. Many delegates remarked on the quality and content of the programme and the relaxed and inclusive nature of the meeting.

Dr Pierre Verlinden, VP and Chief Scientist at Trina Solar spoke about the research activity at the world’s largest solar PV manufacturer (2014) and the development of crystalline silicon solar cell architectures with increasing efficiency. Dr John Wohlgemuth from the US National Renewable Energy Laboratories (NREL) spoke of the challenges to improve the reliability and durability of PV modules and gave an insight into new product standards that are being developed by the international community.

In the field of thin film PV, Dr Jon Major (U Liverpool) gave details of a new low-cost, not-toxic chloride treatment for the fabrication of CdTe solar cells and Mr Raymond Knappen (VDL Flow, The Netherlands) described the development and operation of new roll-to-roll equipment for the atomic layer deposition of buffer layers for CIGS solar cells.

In CPV and OPV, Dr Tom Tibbits (Fraunhofer ISE, Germany) described the structure and fabrication of the world record 46% efficient concentrator photovoltaic (CPV) cell developed at the Institute of Solar Energy in Freiburg, Germany and Prof James Durrant (Imperial College London) spoke of the challenges and opportunities in organic solar cells (OPV).
A hot topic for solar PV is the field of storage to delay the consumption of solar electricity to evenings where domestic demand is greater. Dr Matthias Kauer (Sharp Laboratories of Europe) described new battery storage and inverter products for residential PV systems and contrasted the differing system requirements in USA, Japan and Europe. Finally, Dr Rolf Crook (U Leeds) described a new technique to model minutely-resolved solar PV generation from hourly recorded weather observation data.

The Conference Dinner and Awards Presentation was held in the Great Hall at the University of Leeds and preceded by a drinks reception with live music from a student string quartet. The Best Paper was awarded to George Koutsourakis et al. (U Loughborough) and the Best Poster was awarded to Annette Pressman et al. (U Liverpool). An award for Best Student Poster, sponsored by the Institute of Physics: Materials and Characterisation Group, was presented to Vasil Stoichkov (U Bangor).

Selected quality papers presented at the meeting have been submitted to the editors of either IET Renewable Power Generation (RPG) or Maney Publishing Materials Research and Innovation (MRI) for potential publication.

A small exhibition at the conference included exhibits by Bentham Instruments, Kurt J Lesker Company, IET Journals and Maney Publishing.

PVSAT-11 acknowledges with thanks the sponsorship provided by IET Journals, The Royal Society of Chemistry: Energy Sector, PV Crystalox, SHARP and Maney Publishing. PVSAT-11 also acknowledges the bursaries from SuperGen SuperSolar and The University of Leeds to sponsor fifteen free student tickets. PVSAT-12 will be held at The University of Liverpool from 6-8 April 2016.
The fabrication of components by additive manufacturing techniques has enabled components to be produced without dies or substantial machining, and with reduced lead-time, material waste and cost. It has already established itself in a number of applications. Recent studies have shown that the number of components produced by this technique is predicted to grow substantially over the next decade, especially in the fabrication of metallic components. The microstructure and properties of a component produced by these advanced manufacturing routes is of vital importance to ensure that a product is as good as or even superior to that fabricated by conventional means. The aim of this conference was to bring together the latest research in this field.

The event was held on the 14th May 2015, and was attended by about 60 delegates. The conference was organised by the Structure and Properties of Materials Committee of the Institute of Materials, Minerals & Mining, with support, promotion and sponsorship provided by AWE Plc and the Materials and Characterisation Group of the Institute of Physics.

Speakers at the event described work undertaken by a number of University/Industry collaboration programmes, including work by Swansea University, MTC, and Rolls-Royce, AWE and Imperial College, and research work by the University of Sheffield, the Brunel Innovation Centre, and the University of Manchester.

Talks covered the current capabilities in additive manufacture within UK industry and academia. The unique potential of AM for fabrication of lattice structures and component repair were described. Presentations also covered the microstructure and mechanical properties of AM materials compared to conventional manufacturing routes. The role of defects in limiting material and process utilization was discussed, along with the use, and limits of detection, of Digital Radiography and Computed Tomography for non-destructive testing. Quantification and validation strategies are being developed to allow advanced manufactured components to be safely implemented in applications with demanding geometric and mechanical integrity constraints.

The conference was well received and, reflecting the interest shown, current plans are to hold the event every 2 years.
This event was organised by the IOP Ion and Plasma Surface Interactions Group (IPSI) and supported by the IOP Vacuum Group, the Plasma Physics Group, the Nanotechnology Group, the Materials Characterisation Group and the Thin Films and Surfaces Group.

This one day meeting has become an annual event providing a forum for those involved in using plasmas or ion beams for surface modification and thin film deposition. This year because of relocation of IOP headquarters the meeting went on the road to Loughborough University. Priority was given to young researchers, PhD students and post-doctoral researchers. The event attracted over 60 attendees.

During the conference, a Materials and Characterisation Early Career Prize was awarded to Andrew McInnes of Loughborough University for his poster "Fabrication and Photoelectrochemical studies of Bi$_2$Ti$_2$O$_7$ Pyrochlore Thin Films by Aerosol Assisted Chemical Vapour Deposition" – here being presented with his prize. Congratulations Andrew!
The Nanoparticle Concentration, Chemistry and Interfaces conference was held at Peckforton Castle, Cheshire on 20-24th April 2015. It 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.

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.

In addition to the stimulating scientific programme, delegates were treated to a falconry display with excursions to Beeston Castle or Chester.
Recent Appointees in Materials Science
University of Warwick, 16th-17th September 2015

Report: Dr Claire Dancer (University of Warwick)

The Recent Appointees in Materials Science returned with another very successful conference in 2015. Held at the University of Warwick, and organised by a cross-departmental committee of Dr Gemma-Louise Davies (Chemistry), Dr John Murphy (Engineering) and Dr Claire Dancer (Warwick Manufacturing Group), over 60 delegates spent 2 days attending talks, plenary lectures, panel discussions, a poster session and exhibition, and a very memorable conference dinner at Warwick Castle.

After a welcome from the conference organisers and Prof. Mark Weller (University of Bath) as chair of the Materials Chemistry Division Committee of the Royal Society of Chemistry, day 1 included technical talks from Dr Tung Chun Lee, Dr Tom Hassel, Dr Matteo Palma, and Dr Hugo Bronstein on various aspects of “Materials by Design”. Immediately following on from these talks our first plenary speaker, Prof. Aron Walsh (University of Bath), spoke to us on the topic of “Towards Materials Design by Artificial Intelligence”. As RAMS is as much about career development as it is about science, Prof. Walsh used his talk to give delegates some invaluable tips on managing a large research group and talked about how his career path to date has influenced his research agenda. Judging by the discussion both on twitter and at lunch immediately afterwards his talk was certainly thought-provoking!

Day 2 continued with a session on “Mechanical Properties” which included talks by Dr James Kermode, Dr Ben Britton, and Dr Euan Wielewski. Delegates were also introduced to the National Chemical Database service by Dr Keira McNeice. The technical sessions of Day 1 concluded with a panel discussion on “Careers”. Our plenary speakers Prof. Aron Walsh and Prof. Mary Ryan were joined by Prof. Julie MacPherson (University of Warwick) for a wide-ranging discussion on academic careers. As RAMS is a gathering of recently-appointed lecturers and independent fellows, the questions were very wide-ranging, covering everything from how often to run research group meetings to how to deal with seemingly random opportunities.

With exceptionally high rate of submissions for RAMS 2015 and a limited number of oral presentation slots available, the poster session was unsurprisingly very well populated. Fierce competition for the IOP MC Group poster prize was evident with several posters in the running. In the end our panel awarded the prize to Dr Robert Menzel of the University of Leeds for his poster entitled “Nanostructured Carbon Networks as Electrically-Heatable Support for Layered Double Hydroxides”.

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The conference dinner is always a highlight and this year's was held at Warwick Castle. After a drinks reception featuring some practical demonstrations of metallurgy in action when two knights engaged in a dual (see front cover), dinner was held in the Undercroft Banqueting Hall.

The second day of RAMS dawned bright and early, with Dr Stuart Coles kicking off a session on “Materials Chemistry”, which covered everything from bio-derived polymers, to colloidal semiconductor nanocrystals, to electrochemistry. Following these very interesting technical talks, our second plenary speaker Prof. Mary Ryan talked to us about “Challenges and Opportunities in Interdisciplinary Science”. With more insights into life as an academic, and tips on how to balance academia and the rest of your life, this was another great contribution to the discussion of life in academia.

The final technical sessions were on “Functional Materials” (Dr Sohini Kar-Narayan, Dr Neophytos Neophytou, Dr Kelly Morrison, Dr James Lloyd-Hughes, and Dr John Griffin) and Biomaterials (Dr John Hardy, Dr Elisa Mele and Dr Jamieson Christie), before the conference concluded with a second panel discussion, this time on funding. We welcomed Dr Simon Crook from EPSRC, and Prof. Richard Dashwood and Dr Matthew Gibson from the University of Warwick to join Prof. Mary Ryan for another wide-ranging discussion. Of course with an EPSRC representative in attendance there were many questions on EPSRC funding, but other aspects were also discussed such as how to access industry funding, what’s reasonable to ask your home department to give you in support of a grant, and non-CDT routes to PhD funding. After two packed days, another successful RAMS concluded with tours of the Materials Characterisation and Processing facilities at the University of Warwick.


The organisers would like to thank the sponsors of RAMS 2015 – The Materials Global Research Priority Committee, Institute of Advanced Study, and Warwick Manufacturing Group at the University of Warwick, Royal Society of Chemistry Materials Chemistry Division, Royal Society of Chemistry Publishing, Nature Publishing (Nature Chemistry), the Royal Microscopic Society, Shimadzu, Institute of Physics Publishing (Materials Research Express), and the Institute of Physics Materials and Characterisation Group.

RAMS 2016 will be held at the University of Lancaster on 22nd-23rd September 2016: more information will be available on the IOP Materials and Characterisation Group website and distributed by email to group members.
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 microscopes usually require a good vacuum.

Susannah Speller explained the importance of analytic microscopy in determining the relationships between chemistry, microstructure and properties of superconducting materials including lead-free superconducting joints essential for superconducting magnets. Holly Hedgeland described the development of a scanning helium microscope which gives surface sensitive images with atomic 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 bar. Two routes are being developed; one uses the Avogadro number and does not require vacuum but needs a controlled environment, the other uses the Watt balance in a vacuum and relates the measured force via Planck’s constant to the kilogram. The accuracy of both methods is approaching 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 along 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 TiO$_2$ was required for photocatalytic activity, with applications for self-cleaning glass. By doping the TiO$_2$ with molecular Mo-N or atomic Mo or N using High Power Impulse Magnetron Sputtering the band-gap can be reduced to allow better utilisation of visible and near-visible radiation present in artificial lighting and sunlight.

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.

The representatives of the 5 groups organising the event and the audience agreed that a similar joint programme should be considered for the 7th Vacuum Symposium in October 2016.
High Efficiency Materials for Photovoltaics (HEMP 2015)
10-11 Sept 2015, Imperial College London

Report: Dr Diego Alonso Alvarez, Conference Organiser

The 5th edition of the workshop on High Efficiency Materials for Photovoltaics (HEMP 2015) took place at Imperial College London on the 10th-11th of September, organised by the Quantum Photovoltaics Group (QPV) and the COST Action MultiscaleSolar, and with the support of the Institute of Physics. In this occasion, the workshop was focused on highly mismatched alloys applied to PV (dilute nitrides, bismides and antimonides) but there was also scope for materials for intermediate band solar cells or hot carrier solar cells, among others.

The opening session was given by Andrew Johnson from IQE plc, focused on the industrial perspective of the future of high efficiency photovoltaics and the role that highly mismatched alloys will play on it. With everyone in context, Tomos Thomas, from the QPV group, introduced the latest experimental results concerning the GaAsSbN 1 eV subcell as the key building block for the all lattice matched 4-junction (or more) solar cells. Further applications of bismides in photonic devices were addressed by Stephen Sweeney, from the University of Surrey, building upon the experience on lasers to discuss their impact on photovoltaics.

The workshop gave a fundamental twist with an invited talk by Prof. Eoin O'Reilly on the complexities of the bismides band structure and how such theoretical calculations can be exploited to design suitable alloys valuable for PV. One of the challenges of these alloys is their fabrication, problem that was addressed in the invited talk given by Prof. Mircea Guina, from the Tampere University of Technology, on the GaInNAsSb alloys – with absorption edges ranging from 0.8 eV to 1.4 eV when lattice matched to GaAs – and by Prof. John David, from the University of Sheffield, on the growth of GaAsBi alloys. Finally, Louise Hirst, from the Naval Research Laboratory, focused on the growth of InAlAsSb alloys lattice matched to InP, another material system but that share some of the complexities of nitrides and bismides, such as miscibility gap and the need of post-growth annealing to have good properties.

Highly mismatched alloys and their unique band structure can also be used to exploit intermediate band effects. Prof. Stanko Tomic, from the University of Salford, centred on the use of dilute nitrides in nanostructures, both quantum wells and dots. In turn, Nair Lopez, from the Universidad Autonoma de Madrid, gave an invited talk on the use of bulk dilute nitrides as intermediate band solar cells, showing experimental proof of the working principles of the concept with these type of alloys.
The final presentation involving highly mismatched alloys was the invited talk by Prof. Vesselin Donchev, from the University of Sofia, on the surface photovoltage spectroscopy as a versatile technique to characterise the properties of bulk materials, including dilute nitrides, or nanostructures.

The potential of nanostructures for PV, no longer limited to nitrides or bismides, was addressed first by Prof. Takashi Kita, from the Kobe University, on the dynamics of two photon absorption processes necessary for intermediate band operation. Sabina Hatch, from the University College London, focused her dissertation on the optimisation of InAs quantum dots to maximise the open circuit voltage of the solar cells while keeping extended absorption. Finally, Kasidit Toprasertpong, from the University of Tokyo, presented the latest results on multi-quantum wells and superlattices aiming to 1.15 eV absorption edge for lattice-matched 4-junction solar cells.

A final theoretical talk was given by Urs Aeberhard who showed the limits of the classical, bulk-like description of photovoltaics – in terms of absorption and transport properties – in the frontier between the macro and the nano worlds, for example in the presence of very thin absorbers but before reaching the quantum size.

In summary, the workshop was a complete success, specially in terms of the quality of the speakers, coming from 8 different countries and 3 continents, and the fruitful discussions in the breaks, serving to both strengthen existing collaborations or laying out plans for future projects. The number of posters (10) was also the largest of all the editions of HEMP, so far, encouraging informal talks and networking.

A book of abstracts is available for download on the event webpage: http://www3.imperial.ac.uk/quantumphotovoltaics/workshop

A slideshow of images from the conference can be seen at: https://youtu.be/oZAOy2PU6yI
Recent and Forthcoming Conferences supported by the IOP Materials and Characterisation Group

2016

12th Photovoltaic Science, Application and Technology Conference (PVSAT) 2016
University of Liverpool, 6-8th April 2016
http://www.pvsat.org.uk

Applications of Novel Scintillators in Research and Industry
University College Dublin, 11-13th May 2016
http://spacescience.ie/ansri2016

Nanoparticle Characterisation - Challenges for the Community
Institute of Physics, London, 4th July 2016

8th Joint European Magnetics Symposia (JEMS 2016)
Scottish Exhibition and Conference Centre, Glasgow, UK, 21-26th August 2016
http://jems2016.iopconf.s.org

Recent Appointees in Materials Science (RAMS) 2016
Lancaster University, 22nd-23rd September 2016
http://rams2016.org

Emerging Technologies in Vacuum Science 7 (VS7)
Ricoh Arena, Coventry, 12-13th October 2016
http://www.vacuum-uk.org

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.
MC Group Contact Information

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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