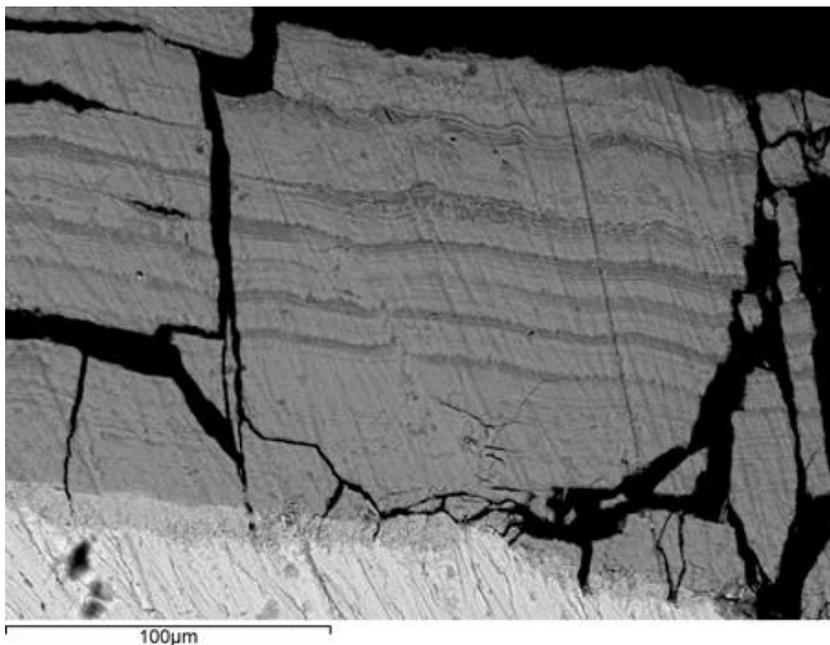


Issue no. 24



Scanning electron microscope image showing sequential layers of corrosion built up on the lead from a stained-glass window obtained by Chris Salter of Oxford Materials Characterisation Service.

See <http://mc.iop.org> for further details

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## Message from the Editor

Welcome to the 2019 Institute of Physics Materials and Characterisation Group Newsletter. In this edition you'll find reports from the conferences we ran and supported during the past year. We sponsored many travel awards and the details of members' experiences of the meetings they attended are contained herein. Since we have a large and diverse membership, we would like to hear from you if there are any items or information you would like to see included in the newsletter.

I would like to thank Alison Crossley for all her efforts in collating the information needed to put this newsletter together. We hope you enjoy reading it, and please get in touch if there is anything the group can do, the contact details can be found on the back page.

[Thomas Hase](#), Newsletter Editor

**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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## **Materials and Characterisation Group Committee**

### **Chair**

Dr Richard Morris CPhys MInstP  
Researcher, IMEC, Belgium

### **Secretary**

Dr Alison Crossley CChem, FRSC, MInstP  
Manager of Oxford Characterisation Services, University of Oxford

### **Treasurer**

Dr Giles Aldrich-Smith MInstP, FIMMM  
AWE

### **Ordinary Members**

Dr Kerry J Abrams  
Department of Materials Science and Engineering, University of Sheffield

Dr Tom Hase CPhys, MInstP  
Reader in Physics, University of Warwick and co-director of the XMaS  
beamline located at the European Synchrotron Radiation Facility, France

Dr Andrew Pollard MInstP  
Science Area Leader, National Physical Laboratory (NPL)

Dr Benjamin Robinson MInstP  
Lecturer in Physics of Functional Materials, University of Lancaster

Dr Annela Seddon MInstP  
Graduate Teaching & Research Fellow/Lecturer, University of Bristol

## Chair's report

Dear M&C group members,

2018 was another successful year for the M&C group. We organized and co-sponsored a number of topical events; welcomed Kerry Abrams to the committee; supported many of our members' applications for travel bursaries and finished the year with a doubleheader, a workshop on Integrated Computational Materials Engineering (ICME) during the day and, our now firmly fixed in the calendar, Christmas lecture in the evening. This year it was given by Michael De Podesta from NPL and entitled "How can you redefine what you mean by a kilogram?"

Be assured, although 2018 was a good year, we will not be resting on our laurels. We have events already scheduled; a Nuclear Forensics (NuFor) event which spans two-days in July, and our Christmas lecture on the very exciting field of gravitational waves. For this we have secured an excellent speaker in Prof Martin Hendry from the University of Glasgow, who will be giving a presentation entitled "Ripples of Gravity, Flashes of Light: the Dawn of Multi Messenger Astrophysics". Please be assured that the Christmas lecture is open to all and is therefore pitched at an appropriate level, it is not just for those in the field. Furthermore, we are again sponsoring PVSAT and RAMS through prizes for best presentations by a student and young academic respectively. Other opportunities for engagement are also being explored and we are always ready to listen to ideas from our members. All the relevant information can be found on our website (<http://www.iop.org/activity/groups/subject/mc/>) and navigate using the link to the events site. Please check this periodically because it is continually being updated.

In the following pages you will be able to read reports of some of our events in 2018. Additionally, summaries from some of our travel bursary beneficiaries are included. I would like to highlight that our committee actively supports our group members when applying for such travel subsidies and therefore recommend applying if eligible. During 2018 we supported 7 students and young researcher travel bursary applications and look forward to receiving and supporting more in 2019. I would also like to conclude by thanking the committee for all their efforts during in 2018 to make the group a success and, Tom Hase for putting this newsletter together for us all to enjoy. Finally, I would like to take this opportunity to wish you all a very successful 2019.

Best regards,

Richard (Chair M&C group) **Email: [Richard.Morris@imec.be](mailto:Richard.Morris@imec.be)**

## Symposium on Nanoparticle concentration – critical needs and state-of-the-art measurement, RSC, 24<sup>th</sup> April 2018

*Report by Alison Crossley (Oxford)*

Alison Crossley, on behalf of the Materials and Characterisation Group who were sponsoring this meeting, attended a Royal Society of Chemistry/National Physical Laboratory Symposium held on 24<sup>th</sup> April 2018. The meeting title was *Nanoparticle concentration – critical needs and state-of-the-art measurement* and the event was attended by over 100 international delegates. The diverse programme had speakers from the UK, Germany, Sweden, USA, Russia, Australia and New Zealand.

The keynote talk was the *LS Theobald Lecture* awarded in memory of Leslie Stuart Theobald, an academic of Imperial College. This Lectureship is awarded to someone who has made a significant contribution to analytical chemistry in an area of work of interest to the Analytical Methods Committee of the Royal Society of Chemistry Analytical Division. The Lecture, on this occasion, was given by **Dr Richard Brown** of NPL. His topic was *Measuring airborne nanoparticles, and related topics*. Dr Brown talked about the significant reductions in black smoke (down one order of magnitude), and polyaromatic hydrocarbons, (down three orders of magnitude), that have been achieved leading to a decrease in pollution over the past thirty or more years. However, he indicated that traffic still causes a problem with pollution. He quoted the Royal College of Physicians report of 2016 which stated that 40,000 deaths per year in the UK result from air pollution. He also noted the response from Professor Sir David Spiegelhalter of Cambridge University who has talked of huge uncertainties surrounding this figure. Dr Brown wished for better data than were quoted in the Royal College of Physicians report and noted that effects on Cardiovascular disease are not reflected in current legislation. He indicated that particle number concentration would be a preferred measurement to use rather than particle mass. He did recognise that huge reductions in particulates have been demonstrated over the past twelve years, based on data from many sites in major cities and elsewhere. He seeks to apply a rigorous metrology approach based on stable measurements that are comparable and coherent so that the data can be of value in an epidemiological study. Within this, it is key to define measurands and specify collection and processing methods.

**Andrea Jaase** of the German Federal Institute for Risk Assessment (BfR) talked about *Linking nanomaterial physico-chemical properties with cellular uptake and toxicity*. She noted the toxicity concerns relating to nanoparticles and indicated that characterisation leading to toxicity is too simplistic and that it is important to add interactions between the nanomaterial and the system, taking account of the initial dose delivered and the internal dose achieved. ICPMS was noted as the gold standard for quantifying nanoparticle uptake in cells with uptake being particle size dependent. There is a need to focus and differentiate between mass and number information regarding delivery to cells. She also expressed concern about getting round-robin data published indicating that it is important to determine and report variability of data across laboratories and techniques. Dr Alex Shard from NPL, UK advised targeting special editions of journals.

**Fredrik Hook** from Chalmers University and Astra Zeneca gave a talk on *Single nanoparticle analytics: from viruses via exosomes to drug delivery carriers*. He discussed a 2D flow concept in the context of improved characterisation of individual nanoparticles of diagnostic and therapeutic significance.

*Nanoparticle reference materials: lessons learned and the case for concentration measurements* was the topic from **Vince Hackley** of NIST. He described the importance of having accredited reference nanomaterials and explained what NIST has to offer. Over 1200 reference materials are currently available. He noted that reference gold nanoparticles are sold worldwide with roughly a 50/50 split between the US and the rest of the world. About 46% are supplied to industry with ~42% to government bodies and ~12% to academia. It was interesting to note that over 100 published papers had referenced these gold nanoparticles with 27 of them referring to spICPMS. He provided insights into potential problems with storage of nanoparticles in suspension with losses to container surfaces particularly problematic for low concentrations. He also advised on using multiple techniques to seek to include the smallest particles in an analysis.

**Michael Krumrey** of Physikalisch-Technische Bundesanstalt (PTB) in Berlin talked about *Nanoparticle concentration with Small Angle X-ray Scattering (SAXS)*. He noted that both Dynamic Light Scattering (DLS) and Small Angle X-ray Scattering (SAXS) are an ensemble method where nanoparticles can be studied in liquid suspension. He noted that traceable size determination of spherical nanoparticles using SAXS is already established with an ISO standard available.

There followed a talk from **Susana Nunez** of LGC Ltd who discussed *Determination of number concentration of inorganic nanoparticles using spICPMS: recent developments and remaining challenges*. She talked about key challenges of spICPMS for achieving accurate number concentration of nanomaterials and talked about the need for effective sample preparation.

A speaker from the Russian Academy of Sciences followed. **Nikolai Khlebtsov** gave a talk on *Determination of size and concentration of gold and silica nanoparticles from absorption and turbidity spectra*, but it was extremely difficult to decipher the data he presented as the slides were very dense.

**Victoria Coleman** of the National Measurement Institute, Australia gave a talk on *Relative nanoparticle concentration with benchtop methods*. She commented that there are no certified reference materials available that are specifically designed for measurements of nanoparticle number concentration but reflected that a number of single particle techniques used for particle size distribution analysis also claim to measure number concentration – these include particle tracking analysis (PTA) and resonant mass measurement (RMM). She had used size-monodisperse gold nanoparticles and specifically prepared modal distributions of these particles to create dilution series for investigating nanoparticle concentrations.

**Kuba Tatarkiewicz** of Manta Instruments Inc in San Diego presented a talk on *What does it take to accurately measure the concentration of particles in colloids?* Manta have developed their own NTA – MANTA – multispectral advanced nanoparticle tracking analysis and have four patents on the technology. They used blue, green and red lasers for different particle size bands and NIST had produced a four-component mix for exploratory studies. He presented results from studies on this four-component mix and for other colloids as well as discussing calibrating instruments that use MANTA.

**Hans van der Voorn** of Izon Science gave a talk on *Nanoparticle concentration measurement is essential and, fortunately, quite easy* and expressed concern that most published papers are not reproducible with ~80% of cancer papers not reproducible. He supported his argument by claiming that Dynamic Light Scattering was the “worst of the main techniques”. He compared IZON’s Tuneable

Resistive Pulse Sensing (TRPS) with NTA/PTA and noted that TRPS can be made accurate for a concentration of a few percent on a linear scale whereas NTA is at best accurate on a log scale. He also reminded the audience that unmeasured does not mean “not there”.

This was followed by a talk from **Hanna Jankecvics Jones** from Malvern Panalytical who gave a talk on *Advances in particle concentration from Malvern Panalytical*. She noted that the NTA process has its own ISO standard and then went on to describe the enhanced capability to be found in the new autosampler accessory for Nanosight's particle tracking analysis (PTA) instrument NS300 kit which gives improved repeatability with increased sample throughput. Round-robin test data were shown supporting the claims for the upgraded equipment. Finally, it was noted that temperature control is key as change in viscosity can lead to change in size measurements so need to equilibrate to temperature.

**Denis Koltsov** of BREC Solutions Ltd closed the symposium with a talk on *Particle tracking analysis for particle counting*. As Chair of the ISO TC 229 committee on nanotechnology, he was able to give details of the current status on standards for nanotechnology. He began by explaining the interactions between ISO, CEN, OECD etc and confirmed that published standards related to nanotechnology now stand at 40 with a further 52 under development. The Particle Tracking Analysis (PTA) method is covered in ISO 19430:2016 with three PTA equipment companies involved in its preparation. Part 2 is pending with particle counting and number concentration to be included. In closing, he reminded the audience of the importance of reference materials.

The meeting attracted many high-quality posters (30) mostly by PhD students with several of them describing novel and emerging methods for measuring nanoparticle concentration. The Materials and Characterisation poster prize was awarded to **Lucien Roach** a PhD student from Leeds who presented his work on morphological control of gold nanorods for medical applications.

In conclusion, this was an extremely interesting symposium with a series of excellent speakers providing an insight into current characterisation techniques.

## Nano-medicine and Characterisation Workshop, London, 10<sup>th</sup> July

Despite public transport issues on the day, 25 stakeholders gathered together to share experiences and issues on this important topic in a workshop organized by the Materials and Characterisation Group.

The meeting commenced with a success story in nano-medicine. **Kevin Lorimer**, a Development Programme Manager from Endomag, Cambridge, UK described how the company have translated a nano-based medical product to the international market. Using its expertise in magnetic sensing and nanotechnology *Endomag* has developed a minimally invasive surgical guidance system which allows surgeons to locate early-stage breast cancers, i.e. those that cannot be felt, with much greater precision. They are currently working on the next generation of magnetic materials and sensing technologies.

The next talk was given by **Dr Theodora Stewart**, Kings College London, UK. Theodora is the lead scientist and manager of the new London Metallomics Facility (LMF) based at King's College London, which focuses on developing correlative metal bio-imaging workflows to advance our understanding of the roles and functions of metals in biology. Her research interests lie at the interface of biology, chemistry and physics, with a specific focus on developing analytical techniques and workflows to quantify temporal dynamics of intracellular metal species, their sub-cellular localisation, and identification of key biomolecules involved in their binding and transport. Key is to minimise disruption to the system of study through the use of both elemental mass spectrometry and synchrotron x-ray spectroscopy based bio-imaging techniques.

Solving particle metrology challenges to deliver better medicines was the subject of the talk given by **Dr Caterina Minelli**, National Physical Laboratory, UK. At NPL Caterina leads the development of metrology for particle technologies and in support of medicine manufacturing. Caterina described how NPL had been working to improve the accuracy of characterisation methods such as X-ray Photoelectron Spectroscopy (XPS) by the refinement of protocols including sample preparation and modelling. XPS has proved to be particularly effective at measuring the thickness of nanoparticle coatings.

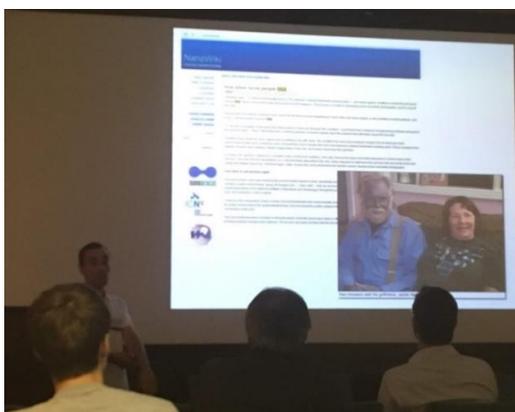
**Dr Eudald Casals**, Vall d’Hebron Research Institute (VHIR), Spain demonstrated the international outlook of the workshop. He delivered his talk entitled *Nanoparticles at work in complex biological matrices*. Currently, he is senior researcher at the Vall d’Hebron Research Institute, a public reference hospital research centre in Barcelona. As well as the impact in the scientific community, his work has been successfully translated into commercial products (BioGAS+), through the creation of a spin-off company (AppliedNanoparticles S.L.) of which he is co-founder and partner. Antibiotic resistance is an important issue to be addressed and characterisation of nanoparticles is key to progressing this. Eudald stressed that there is nothing new about nanoparticles – they have always existed. He stated that the earliest fires would have created carbon nanotubes and that nanoparticles are produced in many natural ways from candle burning to volcanos. It is only now when we can “see” them that we are learning how to control and use them. He also discussed the reactivity of nanoparticles in physiological environments and the formation of protein coatings (corona) which had been described in the 1960s, then known as the Vroman effect.

**Lucien Roach**, the next speaker, is a PhD student at the University of Leeds, UK and his research is centred on the *Synthesis and Shape Control of Gold Nanorods for the Treatment of Cancer*. He is a member of the Molecular and Nanoscale Physics research group under the supervision of Professor Stephen Evans. He talked about his current research interests which are the synthesis and characterisation of gold nanomaterials and the preparation and functionalisation of such materials for application in medical techniques such as photothermal therapy and photoacoustic imaging. Lucien was the IOP Materials and Characterisation Group poster prize winner at the recent RSC-NPL Symposium on Nanoparticle concentration – critical needs and state-of-the-art measurement held on 24 April 2018 at Burlington House London

**Dr Helen Townley** from Oxford University, UK then described her progress in developing new nanoparticle therapies for paediatric cancers. Helen is a University Research lecturer and the William Dodd research fellow in the Nuffield department of Women’s and Reproductive Health, Oxford University, and a Senior Visiting Fellow in the Department of Engineering. Helen’s research centres on the use of nanoparticle therapies and natural product applications for Paediatric Oncology. Studies into paediatric oncology are underrepresented in cancer research programmes, possibly due to the orphan disease status (i.e. 12,060 new

cases of paediatric cancer were diagnosed in children aged 0–14 years in the US in 2012). However, cancer is still the leading cause of death by disease amongst US children. Helen stressed that is not enough to assume that therapies for adults can simply be translated to paediatric cancers; adults and children are known to have different tolerance and response to treatments, and in fact children generally tolerate chemotherapy better than adults since they are less likely to have other health issues. She described a variety of different nanoparticle constructs her group have designed and synthesized to deliver chemotherapeutics, or to treat cancers using the intrinsic properties of the nanoparticles.

**Dr Stephen Wren** AstraZeneca, UK gave the final talk of the day. Stephen works as an analytical chemist in AstraZeneca's product development group in Macclesfield in the UK. AstraZeneca is a research-based pharmaceutical company with 61,000 employees world-wide, and 6,000 in the UK. The product development group has the task of translating new drug molecules, and drug-delivery ideas, into commercial medicines. Stephen works on the development and application of new measurement approaches and systems to improve the characterisation of pharmaceutical products, He is currently working on nanomedicines and in developing the measurement tests required to understand their performance. This includes questions such as the particle size and size distribution, and the rate at which drug is released from the particle. The meeting concluded with informal networking amongst delegates and all agreed there was much more to explore on this important topic.



Dr Eudald Casals, Vall d'Hebron Research Institute (VHIR), Spain with the image of "Blue man" or argyria, a condition caused by over dosing on colloidal silver.

## Group Sponsors Student Poster Prize at Graphene & 2D Materials Conference, National Physical Laboratory, Oct. 2018

*Report by Andrew Pollard (NPL)*

The IOP Materials and Characterisation Group sponsored the Student Poster Prize at the “*Graphene & 2D Materials Conference: From Research to Applications*” at the National Physical Laboratory (NPL) in October 2018. The conference was well attended by both academia and industry, with invited talks from around the world, such as Columbia University, the National Institute of Standardisation and Technology, Haydale Ltd., Trinity College, Dublin, Graphenea S.A., University of Cambridge, Technical University of Denmark, the Graphene Engineering Innovation Centre, and William Blythe Ltd. Over the course of two days, the fundamental science of 2D materials were discussed, alongside the applications of graphene, some of which are now emerging in the market.

The Student Poster Prize was shared jointly between **Ehsaneh Daghigh Ahmadi**, Swansea University (Fully Characterisation of Graphene-based Biosensor Fabricated by Mono-and Bi-layer Photoresist) and **Elisa Castanon**, National Physical Laboratory (Precise method of assembly of 2D heterostructures).



Ehsaneh Daghigh (left) and Elisa Castanon (right) being presented their Student Poster Prizes by Andrew Pollard (NPL).

## Christmas Evening Networking and Outreach Event London, 18<sup>th</sup> December 2018

### “How can you re-define what you mean by a kilogram?”

The Group Christmas Lecture was given by **Dr Michael de Posesta** from NPL and was held on the 18<sup>th</sup> December at De Vere West One London.

This hugely entertaining talk was attended by a diverse audience, including secondary school children. The speaker introduced himself, along with his personalized set of units - the Michael being his unit of length. He contrasted this by explaining why international units are required and why the SI system of units has undergone a makeover to a new set of definitions in terms of universal constants. These are essential so we can make accurate comparisons of measurements around the world.



The new definition of the kilogram replaces the platinum alloy International Prototype Kilogram (IPK) which has been housed in the International Bureau of Weights and Measures (BIPM) just outside Paris. It had been noted that that the IPK could become lighter or heavier depending on the condition of the surface. The new kilogram is based on Planck's constant the value of which has been calculated by determining Avogadro's

constant – the number of particles in a given amount of substance, in this case the number of atoms in a pure silicon sphere. Michael brought along NPS's silicon sphere used for this. After ten years of checking against the old system, the new definition of the kilogram will finally take effect on May 20<sup>th</sup>, 2019.

## IOP Conference Funds



### Early Career Researchers Fund

Providing financial support to early career researchers to attend international meetings and visit international facilities.

### Research Student Conference Fund

Providing financial support to research student members to attend international conferences and major national meetings.

Members can obtain funding, up to a value of £300 from the Materials and Characterisation Group to attend a meeting or conference. 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 are published in this group newsletter over the next few pages.

## Reports on Conferences by students and early career researchers supported by the group

### Doan - 8<sup>th</sup> International Workshop on Characterization of Porous Materials *University of Bristol*

The 8<sup>th</sup> International Workshop on the Characterization of Porous Materials (CPM8): From Ångstroms to millimetres was organised between the 6<sup>th</sup> and 9<sup>th</sup> May 2018 in Delray Beach, Florida, USA. The workshop provided an opportunity to review and discuss the state-of-the-art approaches to characterize porous materials of different origin. Lectures by recognized leaders in porous materials science covered both theoretical principles and the methodology of modern experimental techniques. Some interesting keynote lectures are listed below:

- In-situ synchrotron X-ray diffraction upon gas adsorption and release for exploring unusual adsorption features in porous materials by Conchi Ania, (CEMHTI/CNRS, France)
- Cooperative adsorption and gas separations in metal-organic frameworks by Jeffrey Long, (University of California - Berkeley, USA)

Oral presentations and poster sessions were also given in the conference by excellent speakers from around the world. Many of them were very close to my area, for example:

- Porosimetry: applications and challenges in fluid catalytic cracking by Christian Canlas (W. R. Grace & Co).
- Kerogen-hosted porosity: controls on storage and transport in gas shale by Drew Pommerantz, (Schlumberger-Doll Research)



My poster titled *Controlled formation of hierarchical metal-organic frameworks using CO<sub>2</sub> expanded solvent systems* introduced to scientists a novel method to synthesize metal-organic framework materials via CO<sub>2</sub> pressure for a variety of applications with reduced environmental impacts. In this conference, I had a chance to meet up with leading scientists in my research area such as Matthias Thommes (Quantachrome, USA) and Jean Rouquerol (Aix-Marseille University

- CNRS, France) to discuss further my research. This workshop was also a good chance for me to attend lectures by recognized leaders in porous materials science, so I could learn about both theoretical principles and methodology of modern experimental techniques.

**Wade - SPIE Optics & Photonics Conference**  
*Imperial College, London*

The [SPIE Optics & Photonics conference](#) was held in San Diego between the 19<sup>th</sup> and 23<sup>rd</sup> August 2018 and remains one of the biggest optical sciences conferences in the world. SPIE members span education, research and industry and with over 20 parallel sessions for five days, the hardest part, by far, is choosing where to be and when. My talk entitled *Strong induced chiroptical effects in light emitting polymer blends* was on the morning of the first day, which gave me plenty of opportunities to enjoy the rest of the sessions and meet new collaborators. I work on chiral small molecule – polymer blends of circularly polarised organic light emitting diodes and spent the week moving between everything organic-based (including liquid crystal, characterisation, sensors and hybrid devices). The plenaries were fascinating – from industry insight (*OLED: The Future Display is Here!* – Prof Sang Deog Yeo, LG) to fundamental scientific research (*Making Smart Windows Smarter* – Prof Yueh-Lin Loo, Princeton), the speakers were totally on-top of their game. You can tell that they were great because the packed-out audiences chose the arctic US air-conditioning over the sun-soaked San Diego bay.

Yueh-Lin (Lynn) Loo was one of the most exciting speakers of the whole event – she gave two talks, a plenary on smart windows and an invited session on polymorphism in organic electronics. Lynn Loo invented nanotransfer printing and is an American Physical Society Fellow as well as a World Economic Forum Young Global Leader. Not only was the research fascinating (converting windows into energy harvesting devices and identifying the design rules for molecular polymorphism) but her presentation style was a revelation. She is careful to make sure the audience understand every step of the experiment and the analysis, celebrating the contributions of members of her team. My other favourite talk was from Jennifer Gelinias, a neurologist at Columbia University Medical Centre. Alongside working as a clinical paediatric neurologist, Gelinias is working with George Malliaras and Roisín Owens to develop bioelectronic devices. The team combine soft, biocompatible organic electrochemical transistors with organic ion pumps to sense and treat epilepsy. The devices can work *in vivo*, detecting the minute neural signals that trigger the release of a GABA neurotransmitter. To me, it's just about the most fascinating area of research in the world right now.

SPIE take their student members seriously - they open a day early for a leadership workshop and host a lunch with the experts to offer students the chance to meet award winning scientists. The [Optics Outreach Games](#) are an evening where postgraduates from around the world share their innovative engagement ideas. At the [SPIE Women in Optics presentation](#) we heard about the society's plans for [improving gender equality](#) in the sector and made international allies.

The conference organisers were wonderful – from cheery smiles on the way in to endless networking opportunities – they wanted everyone who attended to make the most of their time at San Diego. From the technical exhibition to the job fair and on-site Starbucks, there was very little they hadn't thought of.

If you work in nanoscience, engineering or spintronics, check out SPIE Optics and Photonics and their spring conference, Photonics West. If you are involved with public engagement, consider applying for their outreach grants / using their free resources. If you know someone who is doing great work in optical engineering, nominate them for an SPIE award. And if you want any advice, please get in touch with me! I would be happy to discuss optics, photonics or San Diego with another likeminded physicist. I loved it so much I registered as a member and am keeping my fingers crossed, I can attend another conference soon.

### **Forster - ECSCRM 2018**

*Swansea University*

The biannual European Conference on Silicon Carbide and Related Materials (ECSCRM) was held over the period 2<sup>nd</sup> – 6<sup>th</sup> September 2018 at the International Conference Centre Birmingham, UK. Over 600 delegates and 91 companies attended the 5-day conference at which over 300 papers were presented – roughly one third of which were oral presentations.

The first day of the conference started with an opening welcome from Phil Mawby followed by 5 short oral presentation from the invited poster presenters. Here we heard about a variety of topics relating to Silicon Carbide (SiC); from solution growth, to stress related measurements through to the development of SOI FETs. Through the rest of the day there were numerous presentations across three main topics. Of most interest was a presentation on *SiC X-Ray Beam Position Monitors for Synchrotrons* by S. Nida from the Advanced Power Semiconductor Laboratory in Zurich. In this talk we saw details of a newly developed four quadrant SiC position sensitive monitor - a potential application for the material that I am currently researching (Al<sub>4</sub>SiC<sub>4</sub>) could be applied. The day concluded with a poster session followed by an industrial session of talks from the companies sponsoring the conference.

The second day of the conference came with twice as many topics: MOS Interface Processing, Power MOSFET, ION Implantation, MOSFET Interface Stability, 4H-SiC Epitaxy, Fundamental Properties, MOS Interface Characterisation and 3C-SiC. The presentation of most interest this day was a presented by W. Klahold titled *Newly Resolved Phonon-Assisted Transitions of Fine Structure in the Low Temperature Wavelength Modulated Absorption and Photoluminescence Spectra of 6H-SiC*. This talk gave insight into the

absorption and photoluminescence processes along with detailed information on the phonons found in 6H-SiC - something which we have already looked at for Al<sub>4</sub>SiC<sub>4</sub> but by different means. The day finished with a pub event run by Wolfspeed, the main sponsor of the conference, here drink and food were provided with live music.

The third day saw 6 topics presented Solution Growth, High Voltage Devices, Devices Ruggedness, Quantum Defects, MOS Interface Processing and PVT Growth. Two presentations under the topic of Solution growth were of most interest. These two presentations gave details on the solution growth of 4H-SiC and detailed the defects that were seen in the crystal structures. Such defects have also been seen in Al<sub>4</sub>SiC<sub>4</sub> and this gave us details as to what they were. As this day led into the last evening of the conference, a gala dinner was put on at the National Motorcycle Museum.

The fourth day was shorter, here only three topics were discussed: SiC Integrated Circuits, Contact and other Processing, and Carrier Lifetime. All were very interesting presentations with one being dedicated to the late Bengt G. Svensson. Most interesting was a presentation by F. Roccaforte titled *Fabrication and characterization of Ohmic contacts to 3H-SiC layers grown on Silicon*, here a means of making an ohmic contact onto 3C-SiC was introduced, details of such could lead to enabling ohmic contact with Al<sub>4</sub>SiC<sub>4</sub>. The conference concluded with closing thanks, a summary of each of the topics and information as to when the next conference would be and where.

All in all, it was a very interesting conference with lots of insights and information to take home and help me in complete my PhD.

### Di - IMMS10 conference University of Bath

In this conference, which was held between September 10<sup>th</sup> – 13<sup>th</sup>, UCLA, I gave an oral presentation *Mesoporous Titania synthesized from amphiphilic polyoxometalate (POM surfactant): extending the application of polyoxometalate*. This topic involves the synthesizing of POM surfactant the resultant characterization of the micelles formed by the POM surfactants using conductivity and small angle neutron scattering. The application of POM surfactant, either to make mesoporous titanium dioxide or mesoporous silica was discussed in which the polymer tails are burnt away leaving POM inside mesoporous materials. The POM@TiO<sub>2</sub> materials have been proved to have better photocatalytic property in degrading Rhodamine B compared to mesoporous TiO<sub>2</sub> templated by SDS only. At the end of the presentation, I answered some questions and appreciated additional comments from the audience. Also, after the presentation, attendants who were interested in my project came and talked with me, which gave me more inspiration on my project.

The conference has had a profound impact on my research career. During the whole conference, I had chances to first listen to the talks which are very relevant to mesoporous materials. The first talk was about to control the morphology of mesoporous silica, they managed to make a specific structure with two different mesostructures. This talk really impressed me, the work they did is amazing plus they can control the morphology. Also, some of the talks were related to the application of silica to drug delivery. The one I am really impressed with is given by Prof. Michael Sailor, who made porous silicon first, and then made porous silica from silicon. The porous silica is widely used for drug delivery and has been proved to be effective in mice. Secondly, I have the chances to listen to the works about mesoporous  $\text{TiO}_2$ , I have discussed this topic with several PhD students from UCLA and Fudan University. One student's project involves decorating  $\text{TiO}_2$  to improve its photocatalytic properties. We discussed how to find out the mechanism that underpins the improvement of these properties. This discussion has helped me think how I could apply the same techniques to explore system as well. Therefore, I really benefited a lot from attending the conference.

This conference was very specific on mesostructured materials which is very relevant to my project. I have been synthesizing mesoporous silica since the beginning of my PhD. But I have not gone into much depth regarding their applications. In this conference, I have seen a lot of applications that mesoporous silica could be used for. Either drug delivery or thermal insulators. Therefore, I decided to continue future research on one of these specific areas. This conference has also allowed me to talk to the researchers from both academia and industry to find potential opportunities to work.

Compared to other conferences that I have attended, I have gained much more in this conference. Therefore, I really recommend people to go to conferences that are very relevant to your own research areas. And before you go to the conference, you'd better go through all the invited talks, and highlight the one that you prefer to go. Therefore, you will not miss the one that you are really interested in.

I very much appreciated the financial support from Institute of Physics, which allowed me to go to the IMMS10 conference.

**Yi-Chao Zou** - 19<sup>th</sup> International Microscopy Congress (IMC 19)  
*University of Manchester*

The Early Career Researchers Fund (ECRF) was used to support my visit to Sydney, Australia, to attend the 19<sup>th</sup> International Microscopy Congress (IMC 19) which was held between the 10<sup>th</sup> and 17<sup>th</sup> September 2018. Held every 4 years, IMC is the largest exhibition in the world dedicated to microscopy, imaging techniques and analysis. As my research project relies heavily on scanning/transmission electron microscopy (S/TEM), the subject of this conference was extremely relevant to my research field. The subject of my poster/mini-oral that I presented studied the effect of composition has on the atomic structure of low-dimensional  $\text{Mo}_{1-x}\text{W}_x\text{Te}_2$  nanostructure using S/TEM.

The first plenary talk was given by the Nobel Prize winner Prof. Dan Shechtman. His talk described his discovery of quasicrystals using electron diffraction in a TEM. His talk really inspired the audience. He showed extraordinary resilience when he was trying to convince the world that quasicrystals do exist. The plenary talk which is particularly interesting to me was presented by Prof. Jennifer Dionne about her group's work on understanding the phase transition in Pd nanorods in a  $\text{H}_2$  gas environment. She described how they applied electron energy loss spectroscopy (EELS) to track the uptake of hydrogen in nanomaterials, which is a useful guidance for my future in-situ S/TEM experimental design.

At the first four days of IMC 19, there are more than 100 oral presentations presented each day, which covered almost all the areas in microscopy from optical to electron microscopy, with applications to different fields including biology, chemistry and physics. Most of the time, I stayed in the meeting rooms that were on the topics of in-situ microscopy, diffraction and phase-related techniques, and nanoscale materials. I was impressed by quite a few in-situ S/TEM talks that showed Ångstrom level resolution. For example, Dr. Raymond Unocic talked about his observation of how two-dimensional materials grow in a heated holder using an aberration corrected S/TEM, which is quite interesting as the growth mechanism can be understood on an atomic scale. I was also interested in those presentations on electron-beam effects, as I am currently involved in a research project studying beam sensitive materials. For instance, Prof. Nigel D. Browning talked on how dose rate influences the growth of nanoparticle during an in-situ S/TEM liquid-cell experiment, and imaging processing techniques such as compressive sensing to acquire/reconstruct images collected from dose-limited experiments.

I found IMC 19 was a success. I met a diverse group of scientists that increased my knowledge in electron microscopy, and potential collaborators that might help the future research in our groups.

**Abdi-Jalebi - 4th International Conference on Perovskite Solar Cells and Optoelectronics (PSCO-2018)**  
*University of Cambridge*

*Conference Highlights:*

The 4<sup>th</sup> international conference on perovskite solar cells and optoelectronics (PSCO-2018), held in Lausanne (Switzerland) between the 30<sup>th</sup> September to 2<sup>nd</sup> October 2018, was focused specifically on hybrid organic-inorganic perovskite materials which have shown remarkable properties as a semiconductor for photovoltaic and other optoelectronic applications (light emitting diode-LED and transistors). The conference started with fruitful tutorial talks by Prof. Md. K. Nazeeruddin (EPFL), Prof. David Cahen (Weizmann Institute), Prof. Filippo De Angelis (CNR-ISTM) and Prof. Stefaan De Wolf (King Abdullah). These talks were focused on fundamental and device physics of perovskite materials where followed by valuable questions and comments from the audience who raised the main challenges in this fast-growing field of photovoltaics. PSCO-2018 was then followed by more specific talks from both senior academics (e.g. Prof. Mercurio Kanatzidis - Northwestern, Prof. Edward Sargent - Toronto, Henry Snaith - Oxford, etc.) and junior researchers about the most recent area of their research on perovskite materials and optoelectronic devices. The main challenge of this technology, which is stability, attracted much attention during the conference as many talks and posters were devoted to understanding the degradation mechanisms and ways of improving the stability of devices under working conditions. In addition, some research groups (e.g. Aldo Di Carlo - Rome) together with active companies in the field (e.g. Oxford PV) from various parts of the world presented the way to make perovskite devices on a large scale, which shows outstanding efficiency (e.g. record efficiency of 27.3% for silicon/perovskite tandem devices) with decent stability.

*Benefits of attendance:*

The conference was very helpful for me as I had a chance to have interactions with senior scientist in my field of research, which lead to very fruitful discussions. In addition, I have spoken to many researchers who are experts in powerful characterisation techniques in order to setup future collaborations. Finally, I had a chance to present my recent research to an expert audience, from which I got some very useful feedback and suggestions that can help to improve the quality of my future work.

*Success of the conference:*

The PSCO-2018 was a very successful conference, which gathered many senior scientists and engineers from all over the world who shared their most recent researches in the field of hybrid organic-inorganic perovskite materials. In addition, many challenges and issues to industrialise this technology were raised in discussions between academics and

companies, which hopefully can lead to the development of a low-cost and highly efficient optoelectronic devices (e.g. Solar cell or LED).

*Relevant and interesting information to non-attendees:*

Lots of interesting topics were presented during PSCO-2018 that was worth highlighting. First, a tandem architecture of silicon and perovskite materials was presented by Oxford PV (UK) as well as the Snaith (Oxford) and McGehee (Stanford) groups who presented a record power conversion efficiency of 27.3% which is higher than single junction silicon solar cells (26.1%). Furthermore, the fascinating results for lightweight full perovskite-perovskite tandem device were also illustrated.



**Charles** - *4th International Conference on Perovskite Solar Cells and Optoelectronics (PSCO-2018)*  
University of Bath



The end of September 2018 saw scientists from around the globe meet in Lausanne, Switzerland for the 4<sup>th</sup> International Conference on Perovskite Solar Cells and Optoelectronics (PSCO for short). Perovskites are the new ‘wonder material’ in photovoltaics (PV), able to produce cheap and highly efficient devices. Their popularity has skyrocketed within the PV community, a quick Web of Science search revealing over 5800 papers published on perovskites in 2018 alone. With such a fast-paced field, PSCO provided an ideal opportunity for perovskite researchers from around the world to meet and discuss new scientific ideas.

The IOP Materials and Characterisation group generously granted me funding to attend this important conference, which enabled me to present my PhD work to leaders in the field. It was a little intimidating as the audience was probably the most expert, I had ever presented in front of, but it was an invaluable experience. On the last day I was thrilled to accept one of the prizes for best oral presentation for a contributing talk.

One of the take home messages from the conference was how close to commercialisation perovskite technology is. Start-ups such as Oxford PV are taking perovskite solar cells out of the research laboratory and into the real world, deposited on top of the more familiar silicon solar cells. The cost of solar energy has plummeted rapidly over recent years, now being cheaper than coal. The goal of including perovskite technology in photovoltaics is to achieve even higher efficiencies but at a similar cost to that already being achieved. In a world concerned with the move away from fossil fuels, it was both refreshing and exciting to hear from experts in the industry that “cost implies a solar future is inevitable”.

Another conference highlight was hearing from one of the invited speakers talking openly about their rejected papers and having to Google scientific terms after a meeting. Conferences are often a show of success, so as a PhD student it was reassuring to hear how even top professors are challenged. The location of PSCO this year was also second to none. Held at the world renowned EPFL in the Swiss Tech Convention centre (boasting the world’s first window made of dye sensitised solar cells) a stone’s throw away from Lake Geneva.

Unfortunately, there was another highlight that was not as positive, but just as important; the male to female ratio. I was struck almost immediately that as a female delegate I was in the minority, this sadly reflected in the invited lectures list with only 5 of the 19 invited speakers female. During the conference the first woman to win the Nobel Prize in Physics in 55 years, Donna Strickland, was announced, excellent progress. But, for me, the award’s timely announcement served to accentuate the gender imbalance in our field, and the importance of work that we are all responsible to be part of to erase it.

## Committee Blog: Dr. Alison Crossley



I have served on the Materials and Characterisation Group committee for several years, first co-opted to organise a Group meeting together with the Royal Microscopical Society on forensic science. I have held the posts of Newsletter Editor and Treasurer to the Group and currently I am the Secretary. I have helped organise many meetings on all aspects of materials characterisation. This has been the focus of my career. I led the Materials Characterisation Team for AEA Technology at Harwell before joining Oxford University in 2002 at Begbroke Science Park and establishing the Oxford Materials Characterisation Service, an open access facility operating at the interface of academia and industry. My previous experience includes managing the UK Scanning Probe Microscopy Initiative, managing a UK Micro Nano Technology centre of excellence in metrology, serving on the committees of other learned bodies (RSC, RMS) as well as on steering committees of EPSRC mid-range facilities.



I am a senior research fellow in the Department of Materials, Oxford University, with over 100 peer reviewed publications and am currently an executive board member of an EU project NanoFASE which aims to determine the fate and speciation of nanoparticles in the environment. I have a PhD in Surface Science from the University of Liverpool and over 30 years hands on experience of materials and materials characterisation, specialising in

surface analysis. I'm a keen cyclist and have been on many epic journeys around the world on my bicycle.

## News in Brief

### PVSAT 14 conference:

*Francesco Mariottini*, a postgraduate researcher at the university of Loughborough's Centre for Renewable Energy Systems Technology (CREST), was awarded the Best Student Poster Prize for his work "[Evaluation of Uncertainty Sources and Propagation from Irradiance Sensors to PV Yield](#)" presented at the 14<sup>th</sup> annual conference on Photovoltaic Science, Applications and Technology, London.



Within the same conference, Dr Diane Palmer (also at CREST) was a runner up for the best paper prize with the study entitled "[Estimating Rooftop Capacity for PV: Are we asking the right question?](#)".

**RAMS 2018:** *Yang Jiao* from Cardiff University at the Recent Appointees in Materials Science, 2018 held at Cardiff University was awarded the Runner up Poster Presentation for their poster "*Investigation of microstructural changes in a Zr-based amorphous alloy with nanosecond laser surface melting*".

@IOP\_M+C <https://twitter.com/IOPMC1>



The Materials and Characterisation Group Twitter Communication goes live! Please use this twitter @IOP\_M+C to communicate your materials news with other members of the group and the wider world.

For example, have you just published some amazing work that you would like your fellow group members to see? Or is there a relevant event that we would all be interested in? Watch this space for further news from the Committee.

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

### ***The 15th Photovoltaic Science, Applications and Technology Conference***

University of Warwick, 10<sup>th</sup>-12<sup>th</sup> April 2019

<http://www.pvsat.org.uk>

### ***NuFor – Nuclear Forensics***

University of Bristol, 10<sup>th</sup>-11<sup>th</sup> July 2019

<http://nufor2019.iopconfs.org>

The conference will bring together expertise and influencers from across academia, industry and government to explore challenges, share developments and promote successes in the field of nuclear forensics.

### ***UKSAF 40<sup>th</sup> Anniversary Meeting - "Both ends of the Spectrum"***

Hosted by nmRC, Nanoscale and Microscale Research Centre,

University of Nottingham, 10<sup>th</sup>-11<sup>th</sup> July 2019

<https://www.uksaf.net/>

The UK Surface Analysis Forum (UKSAF) is a society for scientists from academia and industry with a common interest in the techniques and applications of surface analysis.

### ***RAMS2019***

University of Liverpool, 9<sup>th</sup>-10<sup>th</sup> September 2019

<https://rams-uk.com/>

RAMS 2019 aims to help recent appointees in academia and industry to expand and consolidate a national collaborative community, share experiences and create a network of support.

### ***IOP Materials and Characterisation Group Christmas Lecture***

IOP Headquarters, 18<sup>th</sup> December 2019

*"Ripples of Gravity, Flashes of Light: The Dawn of Multi-Messenger Astrophysics"*

Prof Martin Hendry, University of Glasgow

<https://events.iop.org/materials-and-characterisation-christmas-lecture>

## 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.