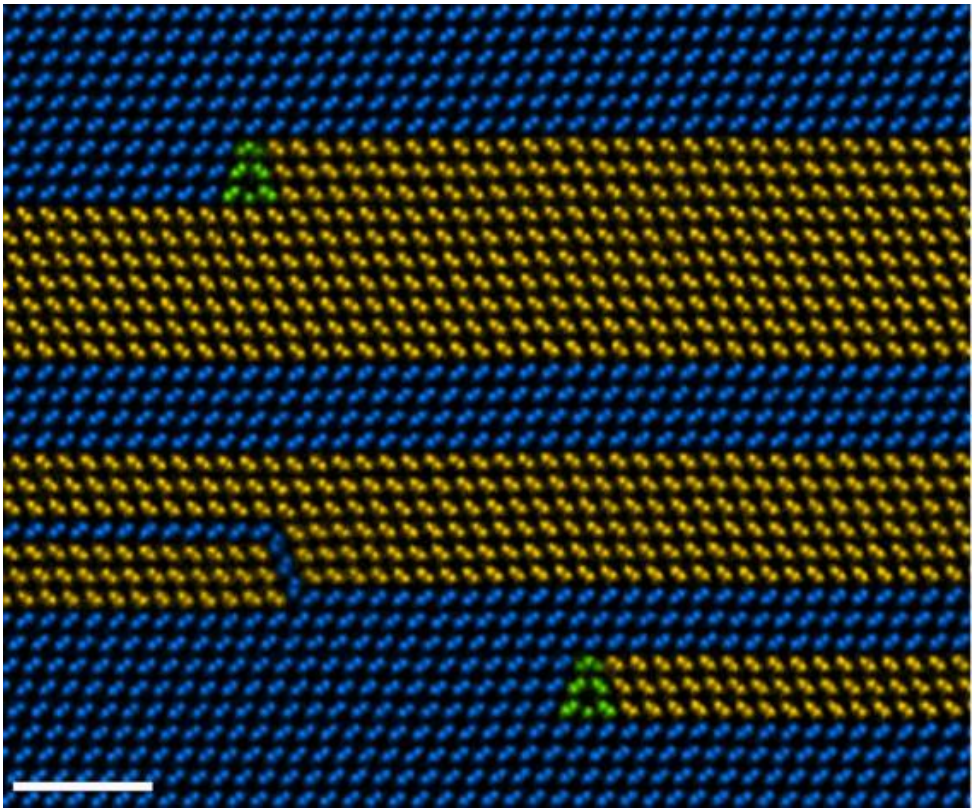
IOP | Institute of Physics
Electron Microscopy and Analysis Group

NEWSLETTER **January 2020**



ADF-STEM image recorded using a JEOL ARM200 double corrected microscope along the <110> direction of GaAsP. The image reveals the presence of defects at the tip of GaAsP nanowires. Scale bar: 2 nm (image courtesy of James Gott, University of Warwick)

See http://emag.iop.org for further details

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26th Australian Conference on Microscopy and Microanalysis *23*
15th European Molecular Imaging Meeting – EMIM 2020 *23*
EBSD 2020 *23*
Electron Microscopy Summer School 2020 *23*
8th International Workshop on Focused Electron Beam-Induced Processing (FEBIP) *23*
17th European Microscopy Congress *23*

EMAG COMMITTEE

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LETTER FROM THE CHAIR

Dear Friends and Colleagues,

I am happy to report on another successful year for EMAG and would like to say the usual thank-you to you as members for your continued support. I would like to welcome our new Early Career committee member for 2019, Dr Laura Clark (University of Glasgow). Special thanks are also due to our outgoing Early Career committee member, Dr Thomas Slater (ePSIC, Diamond Light Source) for his fantastic contributions to EMAG over the last few years.

Our full 3.5 day biennial EMAG conference was again held as part of the MMC conference in Manchester from 1-4th July 2019 and thanks must go to the team at the Royal Microscopy Society for all their support in the organisation of what was a very successful meeting (www.mmc2019.org.uk). The feedback we have had from attendees has been great. We had 170 abstracts submitted to EMAG alone, 1186 attendees at the MMC conference overall and ~ 100 companies represented at the exhibition. The pre-meeting schools were oversubscribed – EMAG's school covered Machine and Deep Learning for which I would like to thank Jun Yuan and Donald Maclaren for organising this. The poster and oral presentations were exceptionally high quality, showing the excellence and diversity of the EMAG community. We had 60 EMAG speakers of whom 20 were female and 27 international. The shorter flash presentations again ran smoothly and we feel that they really do increase the visibility of posters while also encouraging students to present. Look out for the upcoming Special Issue in the Journal of Microscopy associated with this meeting (guest edited by Sarah Haigh, University of Manchester).

Student engagement remains a real feature and goal of EMAG meetings and with that in mind I would like to draw your attention to our exciting **EMAG 2020 workshop** which focusses on **Microscopy enabled by direct electron detection** (page 6). Abstract submission is open now with a deadline of **14 April 2020** and a fantastic group of invited speakers are already confirmed (http://emag2020.iopconfs.org/home). I encourage you all to submit your recent work and look forward to seeing many of you there!

Finally, I'd like to thank Ana Sanchez for putting together this excellent newsletter. This year we have tried to identify and capture the physical science facing Microscopy Infrastructure Access Schemes in the UK. We hope this may be a useful listing for EMAG members and please do let us know if we have missed any. As always we welcome your contributions for future issues. I will also remind you that we do have a Twitter account that we do sometimes even post on (@IoP_EMAG)!!

Best wishes,

Andy Brown
University of Leeds, EMAG Chair

FORTHCOMING EVENTS

EMAG 2020: Microscopy enabled by direct electron detection

Call for Papers

Abstract submission deadline 14 April 2020.

Submit through http://emag2020.iopconfs.org/home

The EMAG conference in 2020 will be held on 6-8th July 2020 in Glasgow, in the historic surroundings of The Royal College of Physicians and Surgeons, and with an opening reception and plenary at The Lighthouse. This single session format conference will focus on **Microscopy enabled by direct electron detection**. We have a fantastic group of invited speakers (see below) who will present alongside contributed oral presentations as well as poster sessions. Prizes will be awarded to the best student contributions (oral, flash and poster). A table-top trade exhibition will be held for delegates to explore the latest advances in instrumentation. Check the conference website for more detail on these as they develop (and please note that you do not need a direct electron detector to submit an abstract!).

Confirmed Invited Speakers

- Dr. Knut Muller Caspary (Jullich, Germany). "*Developments in 4D STEM for momentum resolution and differential phase contrast imaging*"
- Prof. Peter Nellist (University of Oxford, UK). *"Imaging of low-Z and beam sensitive materials using 2D and 4D STEM"*
- Prof. Colin Ophus (Berkeley, USA). *"New phase contrast and diffractive imaging methods enabled by 4D-STEM*"
- Prof. John Rodenburg (University of Sheffield, UK). "*Ptychography - an old name for a modern revolution in imaging"*
- Dr. Carol Trager-Cowan (University of Strathclyde, UK). *"Direct electron detectors for diffraction studies in the scanning electron microscope*"

Abstract submission closes 14 April 2020.

Hyperspy Workshop

2nd – 3rd March 2020 at ePSIC, Harwell, UK

This workshop is aimed to be an introduction to the Hyperspy python package for the analysis of multidimensional data (primarily in electron microscopy). Topics will include an introduction to Hyperspy and analysis of spectroscopic, scanning diffraction and atomic resolution data. Speakers include Francisco de la Peña (Université Lille), Eric Prestat (University of Manchester), Magnus Nord (University of Antwerp) and Duncan Johnstone (University of Cambridge). We anticipate a limited number of spaces will be available for non-ePSIC users, please contact mohsen.danaie@diamond.ac.uk if interested in attending.

SuperSTEM Summer School,

10th - 15th July 2020, SuperSTEM, Daresbury, UK

Please mark your calendars for an exciting upcoming event this summer. SuperSTEM in collaboration with Daresbury Laboratory's Theoretical and Computational Physics Group (SCD) are co-organising the 8th biennial summer school on "Advanced Topics in Cs-corrected STEM and Spectroscopy: Theory meets Experiment". Building on the established series of schools and workshops held at SuperSTEM every two years, this year's school is going beyond the typical syllabus of introductory courses. The school will address advanced topics in Cs-corrected STEM and spectroscopy techniques and introduce theoretical methodologies & computational tools necessary to rationalise and simulate experimental findings. The lectures are intended for PhD students, post-doctoral researchers as well as academics and professionals that have an existing background in electron microscopy or relevant theoretical background. The lectures will be complemented by practical sessions in small groups, including hands on operation of the SuperSTEM instruments and introduction to theoretical calculations. The summer school will take place at the SuperSTEM Laboratory on the SciTech Daresbury Campus in Daresbury. For more details, please see the event webpage: https://www.superstem.org/school2020

EMAG Annual General Meeting 2020

The AGM of the EMAG group will be held as part of **EMAG2020** in Glasgow, UK (http://emag2020.iopconfs.org/home) during the conference (6-8th of July 2020). No fee is charged to attend the Annual General Meeting. Agenda and more details will be circulated nearer the time. If you cannot attend the AGM but have any issues you would like to be raised at the meeting, please contact the honorary secretary (a.m.sanchez@warwick.ac.uk).

NEWS

SuperSTEM Facility updates

Facility Instrumentation: new sample preparation and finishing equipment.

In response to feedback from its user community, the SuperSTEM facility is excited to announce the recent commissioning of new sample preparation equipment. This instrumentation will address one of the known bottlenecks for optimal use of the facility due to the difficulty in establishing sample preparation methodologies for the high-resolution, single atom level, low voltage analytical microscopy capabilities available at SuperSTEM. The new equipment will place emphasis on requirements for minimal surface damage, roughness, and amorphisation of optimally thin samples for low kV observation. These include:

- A Fischione 1040 Nano Mill for FIB specimen finishing and a Fischione 1051 TEM Mill for ion beam thinning have been added to the sample preparation toolkit of the facility. Both instruments are equipped with a liquid N_2 stage for sensitive samples. The equipment is fully open to user access.
- A new multi-source Focused Ion Beam (FIB)/Scanning Electron Microscope column is currently being purchased, with installation and commissioning for user access expected by the summer of 2020. The new instrument will include an exhaustive range of analytical capabilities (including among others EDXS, EBSD and T-SEM).

The new capabilities are available through the usual facility access scheme. Please note that although no formal review process is in place for access to the installed sample finishing equipment, for usage monitoring purposes the facility kindly requests prospective users to submit a short access proposal. As always, requests for beamtime are considered on a rolling basis with no specific call, and are welcome at any time throughout the year.
It is highly recommended to get in touch with facility staff (enquiries@superstem.org) to discuss your project and the instruments' capabilities in detail before submitting a proposal, so your proposed experiments can be tailored to optimise the use of the facility, and ensure you get the most from your visit. More details are available on our website: https://www.superstem.org/facility/access

Queen's University Belfast joins the group of Climate In-Situ users

https://denssolutions.com/queens-university-belfast-joins-the-group-of-climate-in-situ-users/

At the beginning of October, DENSsolutions installed a Climate G system at the Queen's University Belfast, Northern Ireland, UK.
The system will be mainly used by Dr. Miryam Arredondo-Arechavala and her group to study ferroelectrics and other functional materials. Alongside this, it will help accelerate research on ionic liquids performed by the QUILL Research Centre (Queen's University Belfast's Ionic Liquid Laboratories) and other catalyst projects at Queen's University Belfast.
The system was installed in less than two days by our Climate product manager Ronald Marx. After this, Marx provided hands-on training for the new group of users. The team was able to start their first In-Situ Gas & Heating experiment using their own sample of Zeolite particles which were dropcast on to the Climate Nano-Reactor. Seeing the first results in the Talos TEM created a lot of enthusiasm among the group of principal investigators and their colleagues from the chemistry department.

Dr. Miryam Arredondo-Arechavala (centre) in front of the (packed) Climate system, together with her PhD student Tamsin O'Reilly (left) and her Postdoc Dr. Kristina Holsgrove (right).

RESEARCH HIGHLIGHTS by young scientists

The effects of corrosion on silver nanoparticle plasmonics

By Jack Brennan, University of Glasgow

My research concerns the use of electron energy-loss spectroscopy (EELS) to characterise the elemental composition and optical (plasmonic) properties of pure and impure silver nanostructures. Experimental characterisation was undertaken at the University of Glasgow using transmission electron microscopy, and formed the basis of a model of the plasmonic properties of doped silver nanoparticle assemblies. The aim of the work was to develop a framework to accurately predict the plasmonic response of these structures, with a view towards plasmonic tuneability through chemical doping. The nature of silver corrosion was presented, employing nanoscale chemical mapping to show the inhomogeneous growth of a sulphide shell on nanoparticles exposed to standard atmospheric conditions. The erroneous identification of silver oxide as the primary corrosion product in the literature was discussed, with probable causes identified. For example, electron energy loss near edge structure (ELNES) was used to obtain the oxidation state of silver, and revealed that although oxygen was present around some nanoparticles, it must exist within a physisorbed encapsulating shell that does not chemically oxidise the silver. Finally, a boundary element simulation model was presented, using the complex dielectric functions of Ag and Ag compounds to model the plasmonic behaviour of chemically-altered Ag nanostructures. This illustrated the potential for using simple atmospheric exposure to produce dielectric shells that can be used to tune the properties of Ag structures. Large plasmon energy shifts were calculated for nanostructures with sulphide, chloride, and oxide dielectric shells. Preliminary experimental data also showed the effects of a carbon shell on the properties of a nanoparticle trimer, in line with predictions. This work was presented at MMC-EMAG2019, and was awarded runner-up oral presentation.

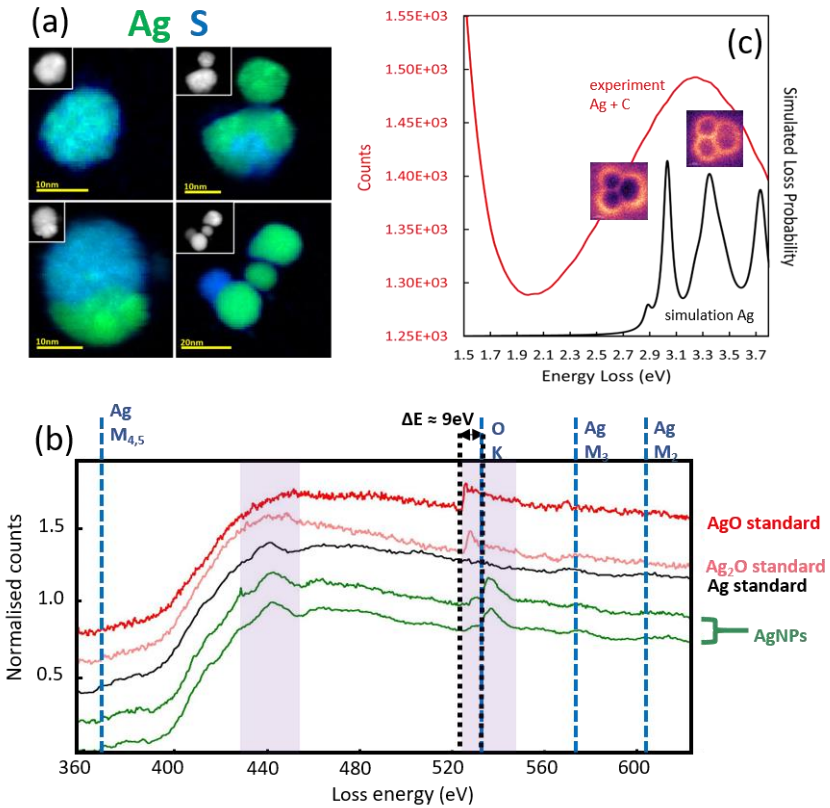


Figure 1: (a) EELS image showing experimental data from Ag NPs aged in standard laboratory conditions. Ag appears green in the image, while S appears blue. (b) EELS spectra from (bottom to top) Ag NP samples, a pure Ag sample, Ag_2O and AgO. Oxygen signals can be detected on the Ag NP samples, but the shape of the Ag $M_{4,5}$ peak, and the position of the O K peak show this is not chemically bonded to the Ag. The rounded Ag $M_{4,5}$ peak and lower energy O K peak in the silver oxide standards are characteristic of Ag_xO compounds. (c) Low-loss EELS spectra from simulation (bottom) and experiment (top), with EELS images in the inset showing the positions of plasmonic excitations at 3 eV and 3.3 eV, moving from a bonding to anti-bonding mode. The simulated spectrum represents an identical coupled pure Ag trimer, while the experimental spectrum shows the peak broadening associated with a thin C shell over the structure, as predicted by our model.

Machine learning for nanoparticle dispersion analysis in complex media

By Martha Ilett, University of Leeds

I am a final year PhD student and was pleased to have the opportunity to present some of my research in the form of a poster and a 5 min flash presentation earlier this year at EMAG-MMC2019. My research, titled 'Machine learning for nanoparticle dispersion analysis in complex media' detailed the development and validation of an automated imaging and analysis workflow to provide a pathway to better understand the dispersion state of nanoparticles in suspension. My work described firstly, the use of a SEM fitted with a STEM detector to carry out automated STEM imaging which allows statistically relevant numbers of images to be collected in a time efficient manner and secondly, the application of machine learning using two open access freeware, ilastik and CellProfiler to carry out automated analysis of these large image datasets in order to determine and examine nanoparticle agglomerate size distributions. It was a fantastic opportunity to present my work at such a well-attended international conference and I was very pleased to be awarded the prize for best flash presentation at the end of the conference. I would like to thank the EMAG committee for giving me the opportunity to present my work, and the prize sponsors.

The work is now published in the Journal of Microscopy; https://doi.org/10.1111/jmi.12853.

Electron ptychography using fast binary 4D STEM data

By Colum O'Leary, University of Oxford

Attending the EMAG conference in Manchester this year was one of the most enjoyable and rewarding experiences of my entire PhD. There were a plethora of captivating talks which both deepened my knowledge of my own research area, and broadened my horizons. I am very grateful to have received the award for 'Best Oral Presentation' for my presentation on Electron ptychography using fast binary 4D STEM data.

The development of fast pixelated detectors (FPDs) for transmission electron microscopy (TEM) and scanning TEM (STEM) has enabled many advances in atomic scale characterisation, from strain mapping, to scanning electron diffraction experiments, to electric field imaging. My area of research focuses on STEM ptychography, an imaging method which utilises the interference in experimental diffraction patterns obtained with FPDs to reconstruct the sample-induced phase shift in an electron wave. One of the main advantages of electron ptychography over other STEM imaging techniques is its sensitivity, enabling imaging of light elements using much lower doses than for annular dark-field (ADF) imaging. The main disadvantage, however, is that FPDs conventionally operate at frame rates in the order of 1 kHz, over 100 times slower than ADF imaging. These slow scan speeds can give rise to distortions, drift and aberration changes upon data acquisition, and limit the minimum electron dose (number of electrons per unit area) practically usable in an experiment.

The research I presented at the EMAG conference explored a method of overcoming this speed barrier by changing the operating dynamic range of a detector. The dynamic range of a detector is the range of possible values that can be recorded in a detector pixel. For some FPDs, the dynamic range can be decreased, and consequently the speed can be increased. By decreasing the dynamic range to 1, such that each pixel could record either 0 or 1, the speed of the FPD was increased to 12.5 kHz. Upon performing ptychography on the data, it was shown that the quality of the images was not affected by the low dynamic range, enabling lower dose focused-probe ptychography experiments. These results will hopefully encourage detector manufacturers to focus on speed and not dynamic range for future ptychography cameras, such that new ultrafast detectors can be developed for biological applications.

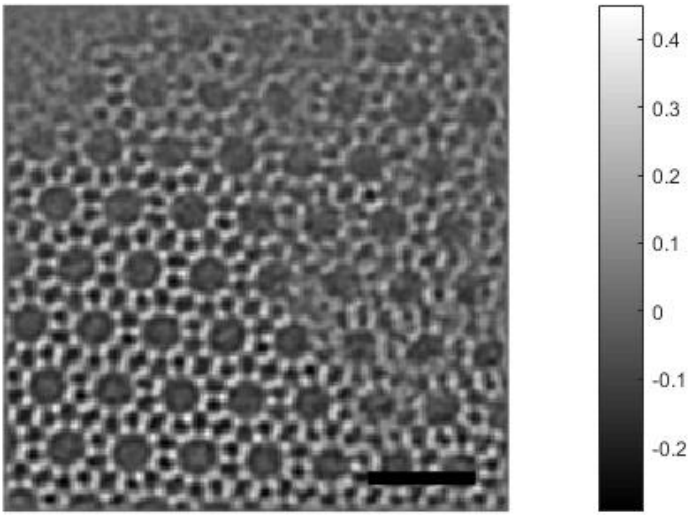


Figure 1: Phase reconstruction of ZSM-5 zeolite using ptychography on binary 4D STEM data.

MEETING REPORTS

MMC2019/EMAG, Manchester

By Prof. Ana M Sanchez, University of Warwick

MMC2019 organised by the Royal Microscopical Society was held in Manchester on the 1-4 July 2019. This international conference brings together the best in Microscopy with six parallel sessions. MMC2019 incorporated three meetings: Frontiers in BioImaging, SPM meeting and EMAG 2019. A huge free exhibition, along with commercial workshop and learning zone, brought together more than 100 companies.

EMAG2019 was a well-attended meeting, with more than 150 communications along 10 different sessions (Electron Microscopy of Functional Materials, Advanced Scanning Electron Microscopy, Electron Microscopy of Functional oxides, In-situ Microscopy Techniques, Low dimensional Materials Structural Materials and Metallurgy, Electron Crystallography and Diffraction, Phase Sensitive Techniques, Electron Microscopy of Nanomaterials and Spectroscopy). Twelve distinguished invited speakers (Dr. Arnaud Arbouet, Dr. Mathiew Kociak, Prof. Carol Trager-Cowan, Prof. Elizabeth Dickey, Prof. Grace Burke, Prof. Randi Holmestad, Prof. Laurance Marks, Prof. Ute Kaiser, Dr. Richard Beanland, Prof. Rafal Dunin-Borkowski, Prof. Caterina Ducati and Prof. Raynald Gauvin) presented state-of-the-art results in microscopy and novel materials, alongside contributed oral presentations as well as poster sessions.

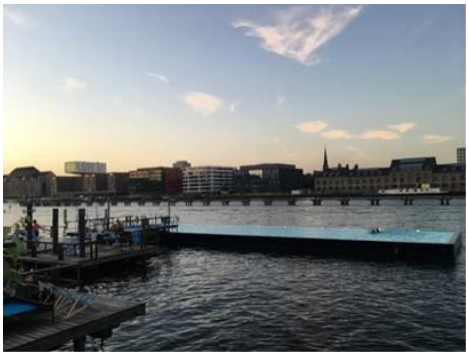
The EMAG meeting finished with our plenary speaker, Prof. Keith Riles, who gave an exciting talk “From Attometers to Gigaparsecs - Gravitational Waves Define a New Astronomy”.

An important aspect of EMAG conferences is to encourage student contributions. Thus, prizes were awarded to the best student contributions. For EMAG 2019 Colum O’Leary (University of Oxford) and Jack Brennan (University of Glasgow) won the best and runner-up oral presentations. There were also flash presentation and poster prizes, awarded to Martha Ilett (University of Leeds) and Laura Wheatcroft (University of Sheffield). For more information about the research of these young electron microscopists see the Research Highlights.

MC2019, Berlin

By Dr. Andy Brown, University of Leeds

This September, the German Society for Electron Microscopy hosted the Microscopy Conference, MC2019 in the Technische Universität Berlin. This was an interesting and enjoyable conference with clear parallels/overlap with our very own RMS/EMAG MMC series held in Manchester in July this year.
Each day began with a strong, diverse range of plenaries and 21 scientific sessions provided a broad and exciting selection of talks on instrumentation and methods, materials science and life science (having a much stronger focus on the physical sciences than MMC). The afternoon poster sessions supplemented the oral presentations and provided time for scientific discussion and general networking. In addition to the scientific programme, a trade exhibition showcased the latest developments in instrumentation and data analysis with a range of lunch-time workshops on hardware/software use, and product development.
For me, the TEM instrumentation and methods talks were of particular interest, such as those discussing the applications of automated software tools, pushing the limits of STEM differential phase contrast and extending geometric phase analysis. In addition, there was clear growth of interest in 3D electron diffraction for crystal structure solution with many talks exploring integration of electron and X-ray crystallography.



As always with all microscopy conferences, it was great to rendezvous with researchers from previous collaborations and meet new people to build links.

The conference's social events were both entertaining and great for networking. Berlin is a fun, vibrant city and I even managed to sneak off for a quick evening dip in the Berlin Badeschiff (see picture)!
The next MC will be held in Vienna 22-26 Aug 2021 and I for one will be aiming to go (www.microscopy-conference.de/)

Microscopy Infrastructures Access Scheme

SuperSTEM

The SuperSTEM facility serves the world-wide scientific community: UK and international researchers alike are welcome to apply for instrument time. The access options include:

- Short studies by any academic user, e.g. an initial set of experiments up to a few days of beam time, are entirely free of charge. Access is granted after submission and evaluation of a short proposal, detailing the project and envisaged experiments. Requests for beamtime are considered on a rolling basis with no specific call, and are welcome at any time throughout the year.
- Longer studies by U.K. researchers, e.g. parts of a wide-ranging proposal including a significant amount of beamtime (for instance, up to 40 days of microscopy over 3 years), require an application specifically for SuperSTEM instrument time through the EPSRC on-line grant proposal system, JeS. For all EPSRC grant/fellowship applications, the cost for instrument time should be requested directly under the "Research Council Facilities" heading.
- Industrial and proprietary research applications are also welcome; commercial rates apply.

The facility highly recommends getting in touch before submitting a proposal (enquiries@superstem.org), in order to discuss the project and the instruments' capabilities in detail, so the proposed experiments can be tailored to optimise the use of the facility, and ensure you get the most from your visit. More details are available on the website: https://www.superstem.org/facility/access

ePSIC

ePSIC, a national user facility for electron microscopy, is part of Diamond Light source and is located at the Harwell Science and Innovation Campus in Oxfordshire. The centre is a collaboration between Diamond Light Source, Oxford University and Johnson Matthey and comprises two aberration-corrected transmission electron microscopes.

Capabilities at ePSIC include aberration corrected imaging in both TEM and STEM, high solid-angle EDX spectroscopy and imaging at both cryogenic and elevated temperatures. One of the key capabilities of ePSIC is 4D STEM diffraction imaging, enabled by the use of a direct electron detector with a frame rate above 1 kHz (Quantum Detector's MerlinEM). Experiments are supported by a team of staff scientists and instrument time is free at the point of access for academic use.

The main access route for ePSIC is through a "Standard Access" application. Scientists can apply through this route whenever calls for proposals are issued; this takes place twice a year with deadlines at the start of April and October. Calls are normally opened six weeks prior to the deadline. Applications are made for

the allocation period in 6 months time, e.g. proposals submitted for the April deadline will be scheduled October-March.

Applications for Standard Access are made online via the User Administration System (UAS). Once submitted proposals are reviewed initially by the facility staff for technical feasibility. An independent Peer Review Panel then make recommendations on microscope time allocation based on the scientific merit of the applications. ePSIC also has a “Rapid Access” route for proposals that meet one of the following criteria:

- The proposal is a short feasibility study, the results of which will inform whether an application is submitted via the standard route for the next allocation period.
- The proposed experiment is necessary to complete a paper that would be ready for submission upon successful completion of the experiment.
- The proposed experiment will contribute towards a PhD thesis that will be completed before the end of the next allocation period and therefore could not wait for the standard access route.

For more information visit https://www.diamond.ac.uk/Instruments/Imaging-and-Microscopy/ePSIC/ or email christopher.allen@diamond.ac.uk.

ESTEEM 3

ESTEEM3 is a network of laboratories and SMEs across Europe, which exists to enable access to electron microscopy facilities to academics in both EU and non-EU countries. ESTEEM3 is funded until the end of December 2022. Small amounts of funding for travel and subsistence may be available from some of the participating facilities. There are 15 facilities to which you can apply to use – with a broad range of specialities across sample prep, (S)TEM techniques and data analysis. Details of the available facilities and the application form are available at www.esteem3.eu. Access to UK facilities by UK users can be possible under certain circumstances, for more information on this, contact Angus Kirkland (Oxford).

Leeds EPSRC Nanoscience and Nanotechnology Facility (LENNF)

Leeds EPSRC Nanoscience and Nanotechnology Facility (LENNF) is a research facility with access funded by the EPSRC for characterisation analysis of soft matter systems such as hybrid organic/inorganic systems. The facility offers access to a unique suite of instrumentation including analytical TEM with cryogenic capability, cryo-FIB, low kV FEG-SEM, and near ambient pressure

(NAP)-XPS, together with EBL and cleanroom capabilities. For more information please contact Dr Mark S'Ari (m.s.s'ari@leeds.ac.uk).

Accessible facilities include a synergistic combination of inter-related techniques for both nano-characterisation and nano-fabrication including:

- **Analytical TEM**
  - FEI Titan3 Themis 300: X-FEG 300 kV S/TEM with S-TWIN objective lens, monochromator (energy spread approx. 0.25 eV), multiple HAADF/ADF/BF STEM detectors, FEI Super-X 4-detector high solid angle EDX system and Gatan OneView 4K CMOS digital camera.

- **Low kV FEG-SEM**
  - Hitachi SU8230: high performance cold field emission (CFE) SEM with 80mm2 Oxford Instruments X-Max SDD detector – Ultra high resolution, low kV, Simultaneous SE, BSE, BF and DF STEM imaging, with nanoscale resolution as well as nanoscale EDX capabilities.

- **Cryo-FIB**
  - Dual-beam FEI Helios G4 CX high resolution monochromated Field Emission Gun Scanning Electron Microscope (FEG-SEM) with precise Focused Ion Beam (FIB), a 150mm2 Oxford Instruments X-Max SDD detector, a Quorum cryo-stage and coating/transfer unit and a range of etch and deposition capabilities for Slice & View acquisition of multi signal 3D data sets and in-situ TEM sample preparation.

- **(NAP)-XPS**
  - Combined UHV/near ambient pressure (NAP) SPECS EnviroESCA X-ray Photoelectron Spectrometer (XPS) system for surface chemical analysis.

- **EBL and cleanrooms**
  - Regional high resolution (< 10 nm) JEOL 6300 electron beam lithography (EBL) system.
  - Class-100 cleanroom for nanoscale device fabrication, including evaporators (thermal and electron beam), sputterers, atomic layer deposition, RIE-ICP etching, PECVD deposition, ion milling, rapid thermal annealing, bonding, dicing, packaging, and associated metrology.

Henry Royce Institute

The Henry Royce Institute is the UK's national institute for advanced materials research and innovation (www.royce.ac.uk). With its Hub at The University of Manchester, the Royce is a partnership of nine leading institutions – the universities of Cambridge, Imperial College London, Liverpool, Leeds, Oxford, Sheffield, the National Nuclear Laboratory, and UKAEA. Funded by the Engineering & Physical Sciences Research Council, the Institute coordinates over 900 academics and over £300 million of facilities and equipment. The Royce supports world-recognised excellence in materials research, accelerating commercial exploitation of innovations and delivering significant positive economic and societal impact for the UK:

The Royce provides discounted equipment access costs and can offer funding for training or short proof of principle experiments for UK based PhD students and SMEs. Our equipment catalogue includes an extensive range of electronic microscopes available across the UK including SEM, TEM and FIB facilities and equipment at Leeds (LENNF, see page 18). The Royce also has other specialist electron microscopy instrumentation including the Plasma FIBs at Manchester and the National Nuclear Laboratory, a SEM in a glovebox at Oxford, a high throughput TEM available at Sheffield, and suites of in-situ TEM instrumentation are available at Manchester and Cambridge (e.g. to allow heating in liquids, electrochemistry, and heating in gases with controlled humidity and residual gas analysis). Visit our equipment catalogue here https://www.royce.ac.uk/equipment-and-facilities/, or call our Business Team on 0161 306 7585 to discuss your requirements. Alternatively, you can contact the relevant electron microscopy facility through the Royce webpage or using the suggested points of contact below:

Cambridge: Paul Midgley (pam33@cam.ac.uk)
Imperial: Mahmoud Ardakani (m.ardakani@imperial.ac.uk)
Leeds (LENNF) : Mark S'Ari (m.s.s'ari@leeds.ac.uk)
Manchester: Helen Ryder (helen.ryder@manchester.ac.uk)
Oxford: Neil Young (neil.young@materials.ox.ac.uk)
Sheffield: Corrine Howse (c.howse@sheffield.ac.uk)

HENRY ROYCE INSTITUTE

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BURSARIES REPORTS (2019)

EMAS meeting May 2019

by BM Jablon, NTNU, Trondheim, Norway

This year's international European Microbeam Analysis Society workshop was held at the Norwegian University of Science and Technology (NTNU) in Trondheim, Norway from May 20-23 2019. The quiet and picturesque city was a nice contrast to the exciting and dynamic microscopy meeting. The conference was preceded by informative, detailed and instructive short courses. Sunday morning there were lectures on the basics of EBSD, quantitative EDS, WDS and EPMA mapping. Afternoon workshops covered the basics of TEM, EPMA maintenance and Monte Carlo simulation.

Trondheim is a beautiful university city located very close to the Arctic circle. In mid-May, the sun barely set and EMAS workshop participants took advantage of the sunlight by enjoying Trondheim late into the night. The city was populated with pubs and students enjoying the warm weather and the enchanting, winding river.

Delegates came from around Europe, Russia, North America and Australia and presented on subjects ranging from geology to metallurgy. The conference days were packed with oral presentations from 9 am into the early evening. Some poster contributors also presented their research in five minute talks. The audience seemed to enjoy the opportunity to hear short summaries of their peers' work. There were tens of posters to browse through during the conference breaks. We were also fortunate to hear from a number of industry innovators on products that will imminently come to market.

There were many fascinating presentations over the four day workshop. One of them was given by Dr. Rhonda Stroud, the MAS president, who travelled all the way from the US Naval Research Laboratory in Washington, DC, to talk about nanodiamonds from earth to the cosmos. The audience was very impressed as she described the analysis of diamonds that reach earth from outer space using a variety of electron microscopy techniques.

One of the most interesting and relevant talks to my research came from a research group in Switzerland, run by Dr. Pierre Lanari. He wrote his own software, XMap Tools, to classify, standardize and extract data from a wide variety of earth science techniques including EPMA, SEM and LA-ICP-MS. I envision a broad use of this tool in the future for a wide variety of academic backgrounds. He also spoke about internal calibrations in an EPMA to track artefacts due to intensity drift, beam damage, and to approximate the real pixel size.

I presented a poster entitled, “Using ECCI and EBSD to study the propagation of dislocations in indented tungsten carbide-cobalt hard metals”. The poster was well received and I enjoyed dynamic conversations on the topic throughout the rest of the day and the conference dinner. I believe that the contacts I made at the meeting will lead to numerous scientific collaborations in the coming months.

The conference dinner was held at Banksalen Hall, an old bank in the centre of town that was turned into an event space. Observant diners were able to identify old phone booths in the basement of the building as well as the bank vault. The safety mechanisms were still in place as were safety deposit boxes. The interesting venue certainly added charm to the evening. Researchers from around the world engaged in enthusiastic conversation for hours about their own research as well as relevant cultural topics today.

I would like to thank the IOP for generously providing the funding that allowed me to attend this riveting conference.

EMS MEMBERSHIP

EMAG members are reminded that they are all automatically members of the European Microscopy Society, at no cost to themselves. However, in order to receive information from the EMS, it is essential to send your e-mail address to the EMS secretary - this cannot be sent by the IOP due to the Data Protection Act. This is important, since almost all communications from the EMS are sent by e-mail, including information for voting for the next Executive Board.

Send your e-mail address (and preferably your other details, postal address, phone & fax numbers) to: secr@eurmicsoc.org and indicate whether you agree to include this information in the EMS Yearbook. If you do NOT wish to appear in the Yearbook, your e-mail address will be used solely for the dispatch of information by the EMS secretary (virginie.serin@cemes.fr).

The EMS web page can be viewed at: http://www.eurmicsoc.org/

EMAG members are also reminded of the availability of EMS Bursaries. For more details, see https://www.eurmicsoc.org/en/funding/scholarships/

ADDITIONAL FUTURE MEETINGS OF INTEREST

26th Australian Conference on Microscopy and Microanalysis
16 to 20 February 2020, *Canberra (Australia)*
https://www.acmm26.org/

15th European Molecular Imaging Meeting – EMIM 2020
24 to 27 March 2020, Thessaloniki (Greece)
http://www.e-smi.eu/index.php?id=1976

EBSD 2020
21 and 22 April 2020, Sheffield (UK)
https://www.rms.org.uk/discover-engage/event-calendar/ebsd-2020.html

Electron Microscopy Summer School 2020
29 June to 03 July 2020, Leeds (UK)
https://www.rms.org.uk/discover-engage/event-calendar/electron-microscopy-summer-school-2020.html

8th International Workshop on Focused Electron Beam-Induced Processing (FEBIP)
08 to 10 July 2020, *Glasgow (UK)*
http://febip.org/

17th European Microscopy Congress
23 to 28 August 2020, Copenhagen (Denmark)
https://www.emc2020.eu/

For more microscopy events see:
http://www.eurmicsoc.org/en/meeting-calendar/calendar/

EMAG contact points

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For conferences:
Email: conferences@iop.org
http://www.iop.org/events/scientific/conferences/index.html

Group matters: Science Support Officer
Email: groups@iop.org

EMS: European Microscopy Society
Email: secr@eurmicsoc.org
http://www.eurmicsoc.org/index.html

MRS: Materials Research Society, 9800 McKnight Road, Pittsburgh, PA 15237, USA.
Tel: +1 412 779 3003, Fax: +1 412 779 8313
http://www.mrs.org/meetings-events

MSA: Microscopy Society of America, 12100 Sunset Hills Rd., Suite 130, Reston, VA 20190, USA.
Tel: +1 703 234 4115, Fax: +1 703 435 4390
http://www.microscopy.org/

RMS: Royal Microscopical Society, 37/38 St. Clements, Oxford, OX4 1AJ.
Tel: +44 1865 248 768, Fax: +44 1865 791 237
Email: meetings@rms.org.uk
http://www.rms.org.uk/events/

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

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