
IOP | Institute of Physics

Electron Microscopy and Analysis Group

NEWSLETTER

September 2013



EMAG2013 Conference Dinner at the National Railway Museum in York. Photo credit: Ian Wright of the York JEOL Nanocentre at the University of York

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

CONTENTS

EMAG Committee	2
A Letter From The Chair	4
EMAG Annual General Meeting	5
Nominations for EMAG Committee	5
EMAG 2013	6
EPSRC Working Group On Advanced Electron Microscopy	7
2013 L'Oreal-Unesco Award for Women in Science	8
Imaging Single Atoms <i>in situ</i> in ETEM	8
175th of RMS: Microscience Microscopy Congress 2014	10
Research Students Conference Fund	10
EMS Membership	11
Future Meetings Of Interest	11
EMAG Contact Points	12

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Dr Roland Kröger

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Dr Vlado Lazarov

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LETTER FROM THE CHAIR

Dear friends and colleagues,

I am writing having just returned from this year's EMAG conference at the University of York. I can say without hesitation that this was an excellent conference with many highlights. This was a particularly well-attended EMAG with over 188 registered delegates in addition to exhibitors, which made it a vibrant conference throughout, whether in the scientific sessions, the poster session or the exhibition. I am grateful to all those who helped in making this such a successful conference including the other members of the committee and the local organizing committee. To name just a few, Cate Ducati as lead programme organizer, Pete Nellist as proceedings editor, Sarah Haigh and Andy Brown in organizing the short courses (together with Mervyn Shannon from SuperSTEM), Ziyou Li as poster session organizer, and all who served as session chairs. In particular, I need to acknowledge the sterling work of Jo Hemstock at IOP conferences with support from Claire Garland in the office and Dawn Stewart at the conference in making our job so easy and take care of all the practical arrangements. Similarly, I wish to thank Charlotte Hockey from CEM for making such an excellent job of organizing the exhibition.

Apart from this, EMAG has been involved in a number of activities in this year. Our immediate past chair, Prof. Pete Nellist, together with Prof. Rik Brydson from Leeds succeeded in attracting a small amount of funding from the EPSRC to support a working panel to examine the future of electron microscopy in the UK in the current aberration-corrected era, to which EMAG is contributing. Pete has contributed a separate article to this newsletter describing this in more detail.

Similarly, in June, the EMAG committee prepared a joint response to a consultation by the House of Lords Science and Technology Committee concerning the provision of Capital Infrastructure in UK Science. A number of points were made, but with the overall tenor that investments in UK electron microscopy are necessary, but should be targeted to benefit the UK Science as a whole and not just individual research groups, and that provision of ongoing support for such major investments including running and staffing costs is essential to achieving the maximum impact from any capital investments. How much effect this will have on research council policies is uncertain, but I take heart from the fact that our community was not the only one making such points.

Also, an EMAG AGM was held at the conference on Wednesday 4th September at 18:00 and provisional minutes thereof and the reports of the Chair, the Honorary Secretary and Honorary Treasurer will be placed on the group webpages at <http://www.iop.org/activity/groups/subject/emag/> in due course.

Looking to the future, the RMS are celebrating their 175th anniversary in 2014, and are holding a MMC2014 in Manchester from 1st-3rd July 2014 to mark the occasion. EMAG have been asked to help in the organisation of two scientific sessions at the conference. One of these concerns Microscopy of Energy Materials and Cate Ducati, Pratibha Gai from the committee are assisting with chairing this session. The other is on Instrumentation, Technique and Data Analysis developments in Electron Microscopy and I will be assisting in chairing this session. I look forward to seeing some of you there.

Finally, in the slightly further future, we will be organising the next full EMAG conference in 2015 in collaboration with the RMS-organised MMC2015 and probably some other microscopy-related meetings, all to be held once again in the excellent Manchester Central venue. There are few details at the moment about this, but over the coming year the major item of business for the committee will be to make concrete plans for our next conference.

So in summary, this has been a busy year for EMAG, and there are plenty of things to look forward to in the coming years.

Best wishes

Ian MacLaren

EMAG ANNUAL GENERAL MEETING

The AGM meeting was held during EMAG2013, at 6pm of Wednesday the 4th of September, at the University of York (17 members attended). The Chair, Honorary Secretary and Treasurer reported on the activities for 2012. The provisional Minutes of the meeting will be posted on the Group's webpage.

NOMINATIONS FOR THE EMAG COMMITTEE

There are vacancies for 2 ordinary members on the EMAG committee. You are invited to nominate candidates as Committee Members. Proposer, Secunder and Nominee must all be members of the Group. No person may propose or second more than one Nomination for any particular post. Please contact the Honorary Secretary to request nomination forms.

Nominations should be sent directly to the Secretary to arrive before the 10th of December 2013.

EMAG2013

EMAG 2013 took place at the University of York between the 3rd and the 6th of September 2013. The Conference was very well attended, with 188 delegates (85 students), 100 exhibitors and representatives the industrial sector, and a good number of international colleagues.

A large audience of students and postdocs attended the three pre-conference short courses organized by Dr Sarah Haigh and Dr Andy Brown, which brought in experts in the fields of aberration corrected electron microscopy, TEM and STEM image simulations, and electron energy loss and x-ray spectroscopy.

The scientific programme of the Conference contained an excellent range of presentations and posters. The Student Presentation prizes were won by Rachel Wallace (Leeds) and Jack Severs (Oxford), whereas the Poster Prizes were won by Renee Van de Locht (York) and Edward Lewis (Manchester). Thank you to all those who shared their scientific results and contributed to the lively atmosphere of the sessions as well as the social events!

One of the highlights of the meeting was the Symposium on “*In situ* microscopy: developments and applications”, held in honour of Prof. Archie Howie’s 80th birthday, co-ordinated by Prof. Pratibha Gai from the University of York.

We record our special thanks to the local organisers: Prof Ed Boyes, Prof Pratibha Gai, Dr Roland Kröger, Dr Vlado Lazarov, Dr Peter O’Toole, Prof Steve Tear, Prof Jun Yuan.



The conference website is at <http://www.emag-iop.org/>

Conference proceedings will be published in the open access Journal of Physics: Conference Series (JPCS) by IOP Publishing.

EMAG 2013 Conference dinner at the National Railway Museum in York. Image courtesy of Ed Boyes

EPSRC WORKING GROUP ON ADVANCED ELECTRON MICROSCOPY

Following some informal discussion within the UK electron microscopy community about coordinating capital investment and recurrent support for advanced EM facilities, a community meeting was held in 2009 to discuss whether there was any support for a “distributed facility” model. One outcome of that meeting was agreement that a working group be established to develop a model or models in more detail. The formation of that working group was suspended during the bidding process and the establishment of SuperSTEM as an EPSRC Mid-Range facility. Recently, Rik Brydson and Pete Nellist have been encouraged by the EPSRC to form a working group to look at the current provision in high-performance electron microscopy, to identify where there are possible gaps and to develop possible funding models.

The working group met for the first time on 11 June 2013, with a second meeting held on 12 September 2013. A more complete description of the aims of the working group, along with the minutes of the two meetings can be found at <http://www.rms.org.uk/outreach/advanced-electron-microscopy-working-group>.

The members of the working group were nominated by the Royal Microscopical Society, EMAG (IOP) and the SuperSTEM International Steering Panel. The members of the working group are listed below:

SuperSTEM nominated

Pete Nellist, University of Oxford

Quentin Ramasse, SuperSTEM

Jeremy Skepper, University of Cambridge

RMS nominated

Rik Brydson, University of Leeds

Ed Boyes, University of York

Paul Brown, University of Nottingham

EMAG nominated

Ian MacLaren, University of Glasgow

Richard Baker, University of St Andrews

Sarah Haigh, University of Manchester

Co-opted

Angus Kirkland, University of Oxford

For more information contact:

Rik Brydson

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or Pete Nellist

(peter.nellist@materials.ox.ac.uk)

2013 L'Oreal-UNESCO AWARD FOR WOMEN IN SCIENCE

The UK Scientist Professor Pratibha Gai has been named the 2013 European Laureate in 15th annual L'Oreal-UNESCO For Women in Science Awards. The award celebrates the outstanding achievements of women in science and is recognised as one of the premier international science awards. Professor Gai was chosen for her pioneering work on environmental transmission electron microscopy: *"For ingeniously modifying her electron microscope so that she was able to observe chemical reactions occurring at surface atoms of catalysts which will help scientists in their development of new medicines or new energy sources."*



The Awards Ceremony took place on 28th March 2013, at UNESCO headquarters in Paris.

To learn more visit <http://www.womeninscience.co.uk/international-news-2.php>

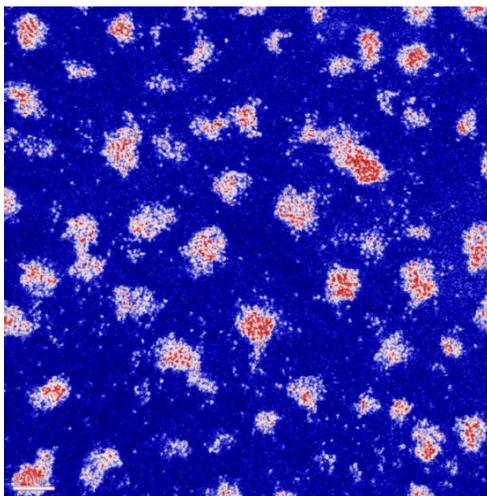
IMAGING SINGLE ATOMS *IN SITU* WITH ENVIRONMENTAL SCANNING TRANSMISSION ELECTRON MICROSCOPY: PROF E D BOYES AND PROF P L GAI (UNIVERSITY OF YORK)

Single atom active sites in heterogeneous catalysts often exist only at operating temperatures in dynamic gas reaction conditions, and *in situ* analysis on the atomic-scale can provide vital information about reaction mechanisms. Professor Edward Boyes and Professor Pratibha Gai at the University of York (UK) have now developed a new environmental scanning TEM (E-STEM). The new electron microscopy technology is allowing researchers for the first time to observe and analyze single atoms, small clusters and nanoparticles in dynamic in-situ gas reaction experiments at operating temperatures.

The new instrument, the first results from which were published as the cover article in the May 22, 2013, issue of *Annalen der Physik*, with an accompanying commentary, enhances the atomic-scale resolution of the same authors' E-TEM, but more importantly now also includes full scanning functionality, double (TEM and STEM) aberration correction, full STEM analytical capability (EDX, EELS), electron diffraction and most importantly high-angle annular dark field (HAADF)

STEM imaging. For *in-situ* studies, the microscope has already been operated at $>500^{\circ}\text{C}$ with pressures of $>10\text{Pa}$ at the sample and $<0.1\text{nm}$ resolution. These developments enable high chemical sensitivity and single-atom resolution in dynamic conditions with continuous gas exposure at elevated temperatures; opening up exciting new opportunities for studying reacting atoms.

To demonstrate the ability of the new microscope, the team first examined a model variant of a system important in the chemical industry with Pt deposited on an amorphous carbon support. At temperatures up to 400°C in 2Pa of hydrogen (see image), the new instrument was able readily to resolve single Pt atoms and co-existing larger Pt nanoparticles in 3D atomic detail. It is now realized that the persistence of isolated atoms can have ramifications directly for reactivity, as well as being an established mechanism for competitive particle growth. The authors note that the work reveals the importance of dynamic single atoms in catalysis under reaction conditions and they can be expected to have energy states and chemical reactivity different from those in a crystal; even a nano one. Additionally, the temperature dependence of the nanoparticle structures was studied, as the clusters evolved from disordered 1-2 layer 'rafts' to more cube-like and bulk-like highly ordered crystalline configurations $\sim 2\text{nm}$ in size when heated for 30 minutes at 500°C under hydrogen. At this temperature, single atoms were not observed to the same extent; due to either their incorporation into the larger particles or their increased mobility and attendant reduced image contrast at the elevated temperature.



Environmental scanning transmission electron microscope (E-STEM) image reveals single Pt atoms and raft-like clusters 1-2 atoms high dispersed on a carbon support under dynamic H_2 gas reaction conditions. Scale bar is 2nm and single atoms measure $0.11\pm 0.01\text{nm}$ FWHM in the newly developed aberration corrected instrument. Image credit: Prof. Edward Boyes, Michael Ward, Dr. Leonardo Lari and Prof. Pratibha Gai.

Prof. Mingwei Chen of Tohoku University, who was not involved with the work, asserts in a *Materials Research Society Bulletin* interview that the new E-STEM "is a promising technique to help us to solve many important catalysis-related questions." The *MRS* quoted 'vast increase' in pressure that the new microscope allows is well into the

surface science 'high pressure' regime of Prof Somorjai. Prof. Chen, Dr Donald Maclaren of the University of Glasgow in a related *Annalen* focus article, and the authors of the paper agree the gas pressures currently available in the instrument are generally enough to saturate the surface of the sample but an increase would provide access to more catalytic reactions. Further developments along these lines, and others with an application focus, are underway; supported by an EPSRC Critical Mass Grant. The York AC ESTEM development provides a new capability; at this point globally and most importantly in the UK.

175th ANNIVERSARY OF RMS - MICROSCIENCE MICROSCOPY CONGRESS 2014

EMAG will join the celebrations for the 175th Anniversary of the Royal Microscopical Society in 2014 by organizing and sponsoring two symposia of the Microscience Microscopy Congress 2014, to be held in Manchester on 1st-3rd of July 2014. The two symposia will be on *Advances in EM instrumentation, detectors and techniques* and *Microscopy of energy materials*. We look forward to seeing many of you there, so save the dates!

The conference website is at <http://www.rms.org.uk/mmc2014>

IoP RESEARCH STUDENTS CONFERENCE FUND

If you are a student member and are looking for funding to attend a meeting or conference, please apply for an RSCF bursary, which may give you up to £250 towards your costs. We have several of these bursaries to give away each year. Check eligibility criteria and download the form at http://www.iop.org/about/grants/research_student/page_38808.html



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For further information see www.iop.org or contact supportandgrants@iop.org

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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 (Prof. Dr. D. Schryvers).

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

<http://www.eurmicsoc.org/scholarships.htm>

FUTURE MEETINGS OF INTEREST

Microscience Microscopy Congress, mmc2014 – 1-3 July 2014, Manchester, UK

http://www.rms.org.uk/events/Forthcoming_Events/MMC2014

18th International Microscopy Conference, 7-12 September 2014, Prague, Czech Republic

<http://www.imc2014.com/>

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Email: conferences@iop.org

<http://www.iop.org/events/scientific/conferences/index.html>

Group matters: Science Support Officer

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EMS: European Microscopy Society

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<http://www.eurmicsoc.org/index.html>

MRS: Materials Research Society, 9800 McKnight Road, Pittsburgh,
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Tel: +1 412 779 3003, Fax: +1 412 779 8313

<http://www.mrs.org/meetings/>

MSA: Microscopy Society of America, 12100 Sunset Hills Rd., Suite 130,
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<http://www.microscopy.org/>

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

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

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