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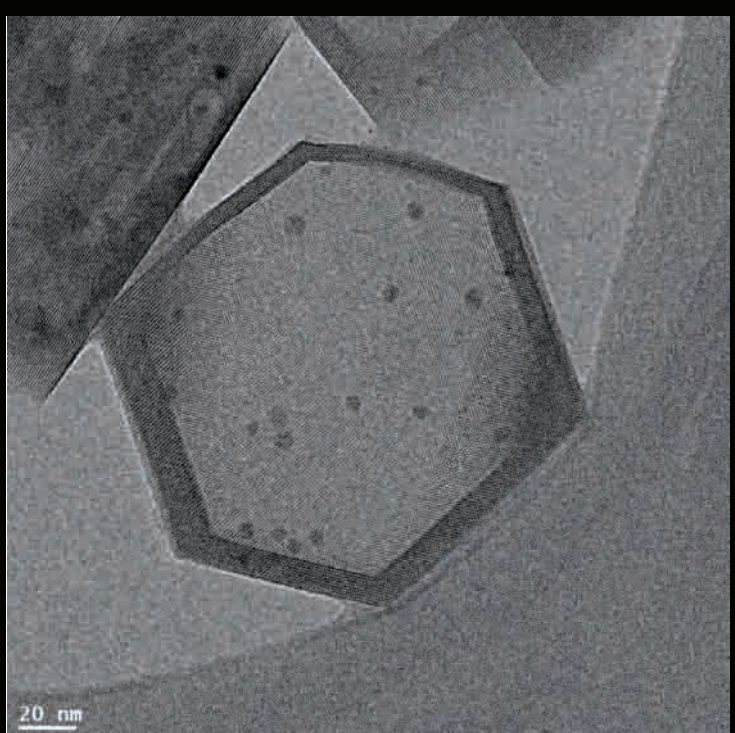

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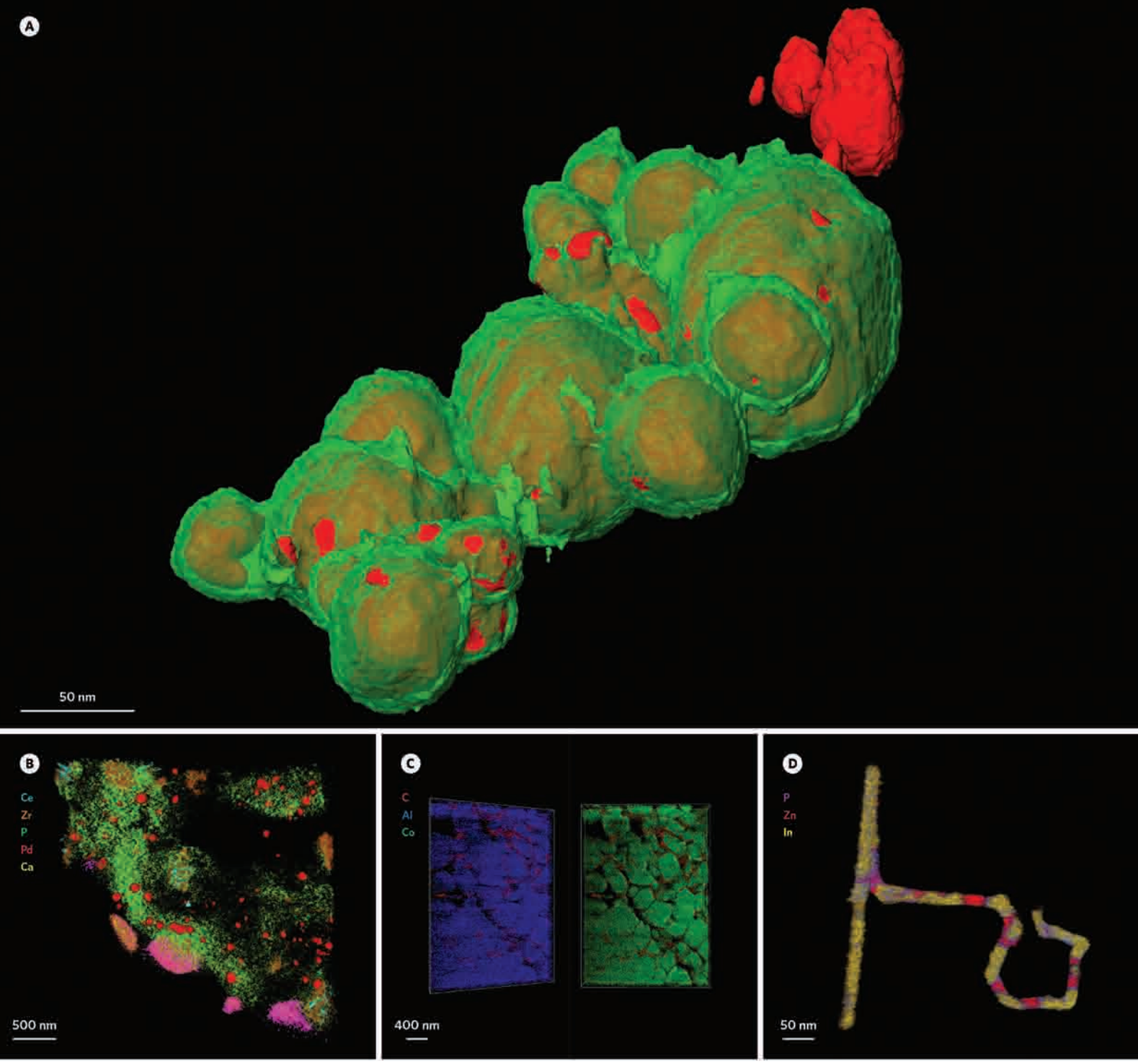

A: EDS tomogram of Ag-Pt core-shell nanoparticles. Ag cores are shown in the false color of red, covered by green-colored Pt shells, only a few nanometers in thickness. Sample courtesy Prof. Yi Ding and Prof. Jun Luo, Center for Electron Microscopy, Tianjin University of Technology. **B: Vehicle-aged automotive catalyst.** EDS tomogram showing the distribution of Palladium particles (red) relative to other elements. **C: Battery anode material.** EDS tomograms of Carbon-Cobalt and Carbon-Aluminum. **D: EDS tomogram of P-Zn-In nanotubes.** Sample Courtesy of Dr. Reza Shahbazian Yassar, Michigan Tech University.

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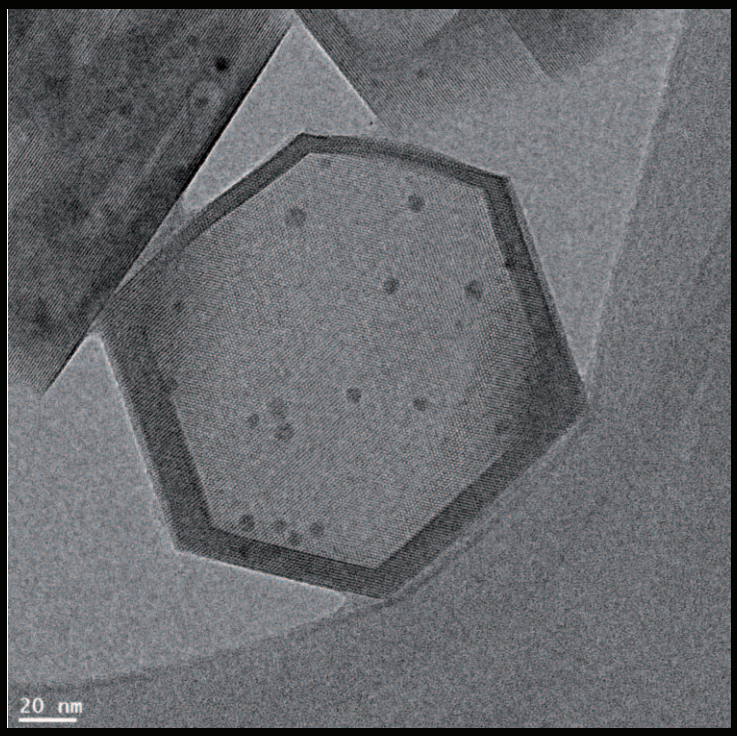

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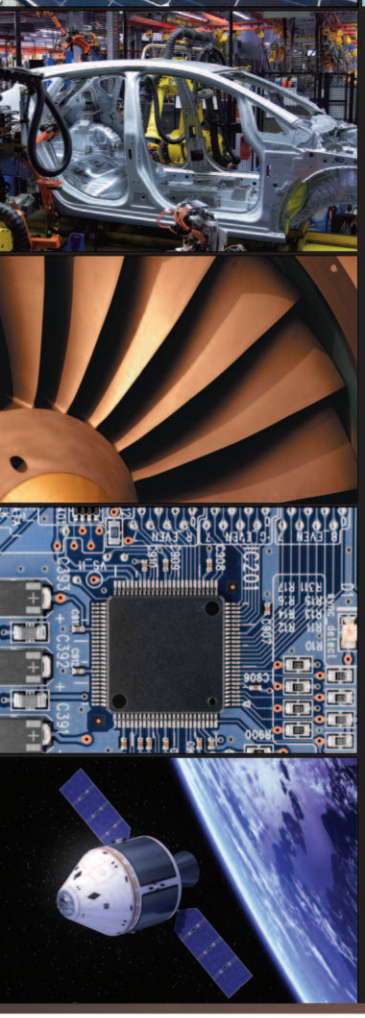

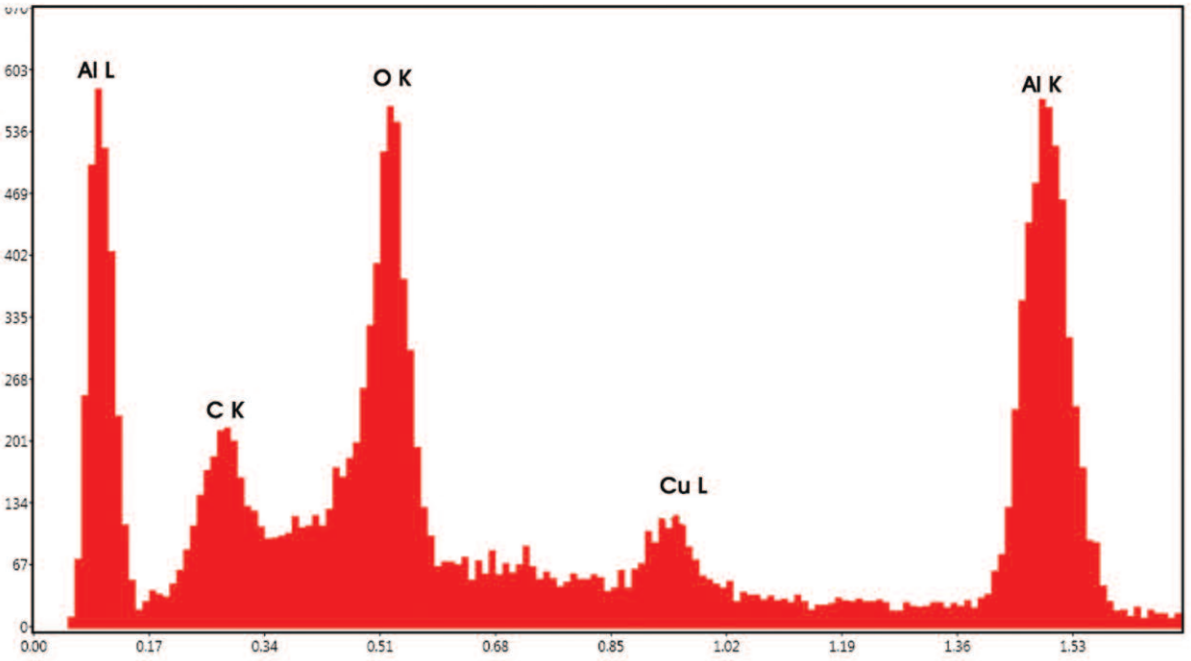

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Preface

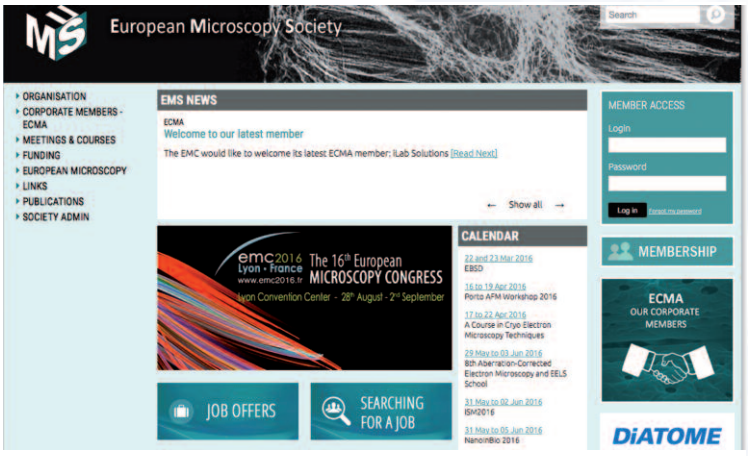
Dear EMS members,

Again another amazing microscopy year has passed. As will be clear when browsing through this 2015 EMS Yearbook, our field is extremely active with many conferences, workshops, courses etc. being organised throughout Europe. Reports of many of those can be found in this issue, alongside the interesting and pleasant notes from the early-stage career researchers that received an EMS scholarship to attend the EMS Extensions in Manchester and Eger and the papers by the two EMS lecturers at Eger. We are also very happy with the reports on various awards received by microscopists, awards from within and also from outside the community. You can also again find a paper on historic microscopes, now with a focus on the early days of optical microscopy in the 17th century.

Next to all the exciting science, in 2015 our society has taken an important step in upgrading the secretarial support with a professional partner. After a round with several competing companies, MCO took up the challenge to continue and further improve the secretarial support to our Board and especially our members. In September the new website was launched and also several new functionalities have been embedded with the membership database. We invite all of you to take another look at these opportunities.

With the quadrennial EMC 2016 organised in Lyon, also the upcoming conference season looks to become unforgettable and we invite all of you to join us in France at the end of August.

Many thanks to all colleagues who have contributed to this Yearbook and to Serap Arbak for the proof reading.



Nick Schryvers
EMS Secretary

Cover : Silver nanoparticles encaged in mesoporous ordered silicalites (TEM 300 kV; micrograph Mimoun AOUINE and coll., IRCELYON/CLYM, Lyon, France)

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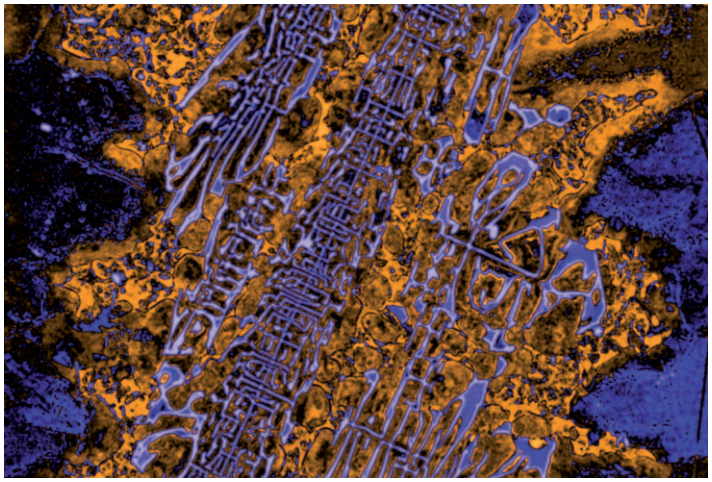

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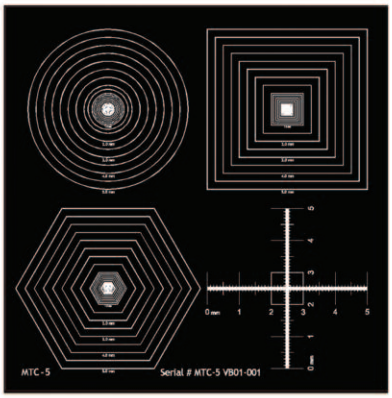

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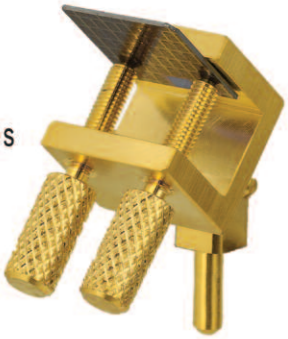

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LETTER FROM THE PRESIDENT

Dear EMS members,

It is our great pleasure that we send you the new EMS Yearbook. As you expect also this Yearbook contains reports from awarded EMS prizes and scholarships, from EMS sponsored events, as well as special microscopy events throughout Europe and from the special highlight of last year, the two EMS extensions Microscience Microscopy Congress (mmc2015) in Manchester, UK, and the Multinational Congress of Microscopy (MCM2015) in Eger, Hungary, which impressively showed that both eastern and western European countries have a very active, vivid and growing microscopy community.

As a tribute to the growing activity in the eastern countries the EMS Board met in Eger for one of the annual board meetings and we all enjoyed a perfectly organized MCM2015 by Hungarian Society for Microscopy Society (HSM). A well-designed scientific program and an adequate exhibition of suppliers showed also their interest to support these countries. This congress was rounded up with an excellent congress dinner. An extensive report on this event can be found on page 14.

Nominations for the 2014 **EMS Outstanding Paper Award** were solicited early 2015 and the jury selected 3 winners, Reza. R. Zamani (Materials Sciences), Radostin Danev (Instrumentation) and Sharon Grayer Wolf (Life Sciences). These awards were presented during the mmc2015 Congress Dinner in Manchester to also highlight the EMS support for the exceptional mmc series. You can find a more detailed report on the EMS Outstanding Paper Award on page 62.

In the course of 2015 the final preparation for the next European Microscopy Congress – **EMC2016 Lyon** - has continued and been finalized by Thierry Epicier and his team together with MCO and we are all looking forward to an exciting scientific program, plenary talks, meetings and workshops at a wonderful venue location and French hospitality in the city of Lyon. We are looking forward to see you all in the week 28th August to 2nd of September 2016 in Lyon, France.

In the mean time EMS continues to sponsor many European meetings in different ways. In 2015 **seven meetings** were selected as **EMS sponsored events**, a larger number as usual, since we had many very good applications and we wanted to support meetings for young scientist, training and scientific exchange in as many regions of Europe and topics as possible. In this Yearbook you will find detailed reports on these meetings on pages 33 to 43.

The selected reports from young researchers who have received one of the 29 **EMS scholarships**, and which are presented on pages 64 to 73, focus on attendees to mcm2015 and MMC2015.

As part of the growing activity in the eastern European countries, we further warmly welcome the new **Romanian Electron Microscopy Society (SREM)**, headed by Dr. Bogdan Stefan VASILE, President, University Polytechnica, Bucharest. At present, they have around 80 members. In 2015 the **EMS membership** is around 5642 members, with 56 corporate members. The detailed lists are given on pages 78 and 79.

As you may have noticed the EMS has a **new Web-Page** - www.eurmicsoc.org/en/ - which not only has received a new facelift, but allows you all more interaction specifically for members, societies and suppliers and enhances the visibility of new activities etc. In addition behind this new design there is also a close link to the EMS secretary and a repository of all activities so that future EMS Board members will have a professional support framework for their volunteer work.

So what is next? Allow me to highlight once more the upcoming **EMC2016 in Lyon** at which you will also have the opportunity to listen to the talks of the **JEOL-European Microscopy Award** winners, given by colleagues who have made an exceptional contribution to microscopy in the fields of Physical/Materials Sciences and Optics or Life Sciences. Get to know the next **EMS Outstanding Paper Award** winners and have the opportunity to **renew the EMS Board** since after 12 years several board members will leave EMS as active board members to free space for the next generation of active microscopist.

In addition, we as a society also want to highlight current matters, which all microscopists face during the meeting in Lyon. **Big Data in Microscopy (Sun. 28th Aug. EMC2016):** we all start to face the problem to handle and store huge amount of data for live and in-situ microscopy and joint investigation by combining various structure research modalities – Big Data not only means recording but also deals with: ABCOD of data (Attributable, Legible, Contemporaneous, Original, Accurate) being complete (Metadata etc.), consistent (Stamps), enduring and fast and easy availability. The second topic is **Managing of Large Microscopy Facilities (Wed. 31st Aug. EMC2016)**: also here as a community we manage to run complex instrumentation and not only sustainable operate these instruments, with attracting excellent young scientists and keeping them in the field, but we also face an increasing financial risk to keep these instruments up and running with increasing acquisition prices and maintenance costs – how can we handle this and are there successful models in Europe others can learn from. We all welcome you to be part of these EMS Workshops at the EMC to find, as a society, solutions for our common future.

The next technology challenges in our field are just ahead to happen and will need even more thorough preparation to handle the frontiers in Microscopy and keep Europe ahead – these instruments will be based on the existing corrected microscopes and will only be realized in a joined effort between scientists, funding agencies and suppliers all together and reflecting the topics mentioned above, if we do not want to get lost in data, cost or lose our leading position in the field.

Allow me to highlight one specific board member who will be one of the members stepping down in August – our secretary **Nick Schryvers** – without Nick being on the EMS board for 12 years I can speak for all former and current EMS board members – the EMS would not stand were it is today – **Nick was and still is the supporting pillar of our society** and we all are **very grateful and owe Nick a big thank you** for all the time, effort and ideas he has given to all of us to make EMS a blooming society with many supported scientifically and training events year per year.

We are eager to meet many of you again in one of next years' microscopy events. In this sense it is an exciting year to look back and say thank-you to all active members and also to look forward to new developments, announcements and a fascinating time in Lyon – hope to see you all end of August 2016 in Lyon.

Roger Wepf
President EMS

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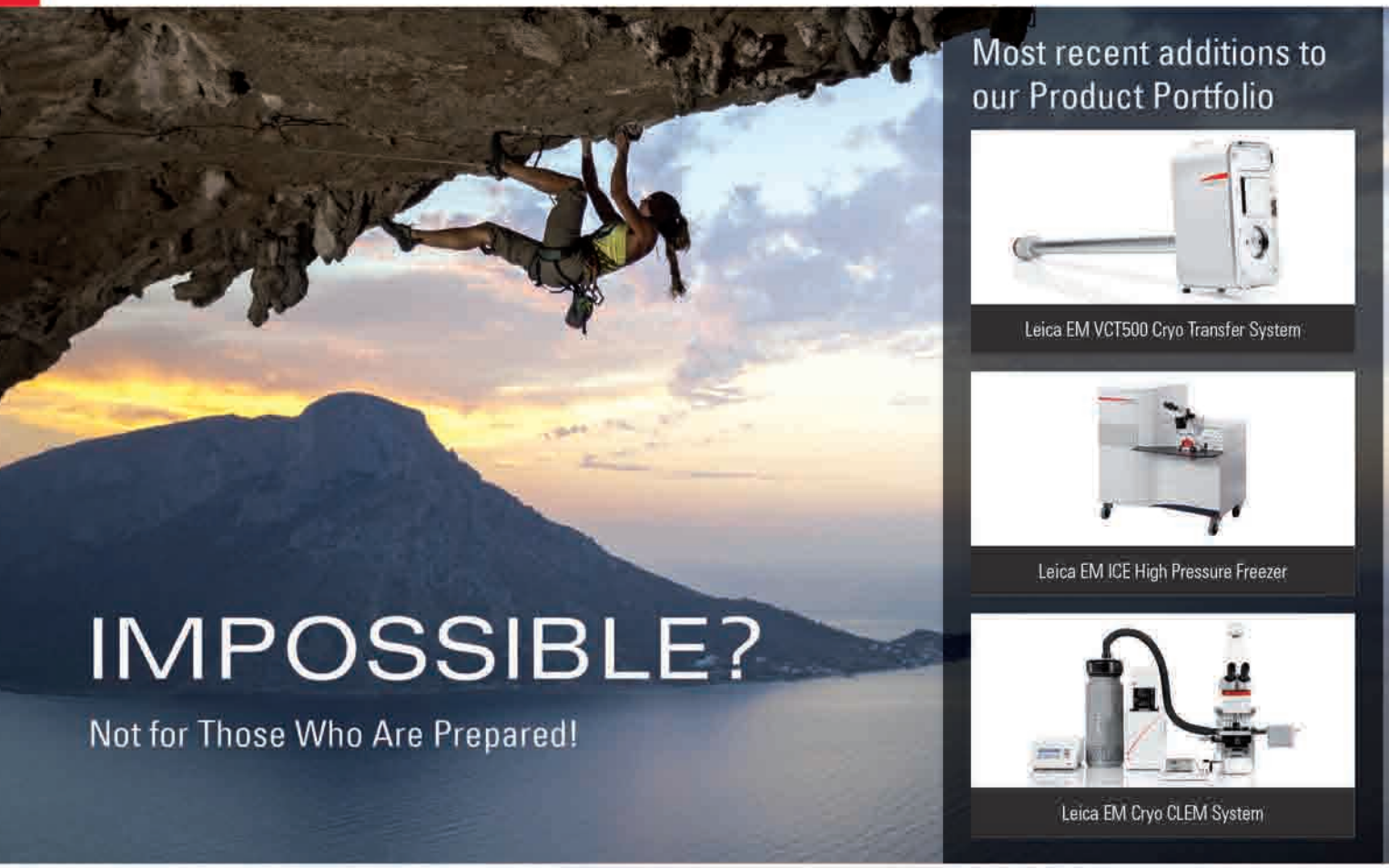

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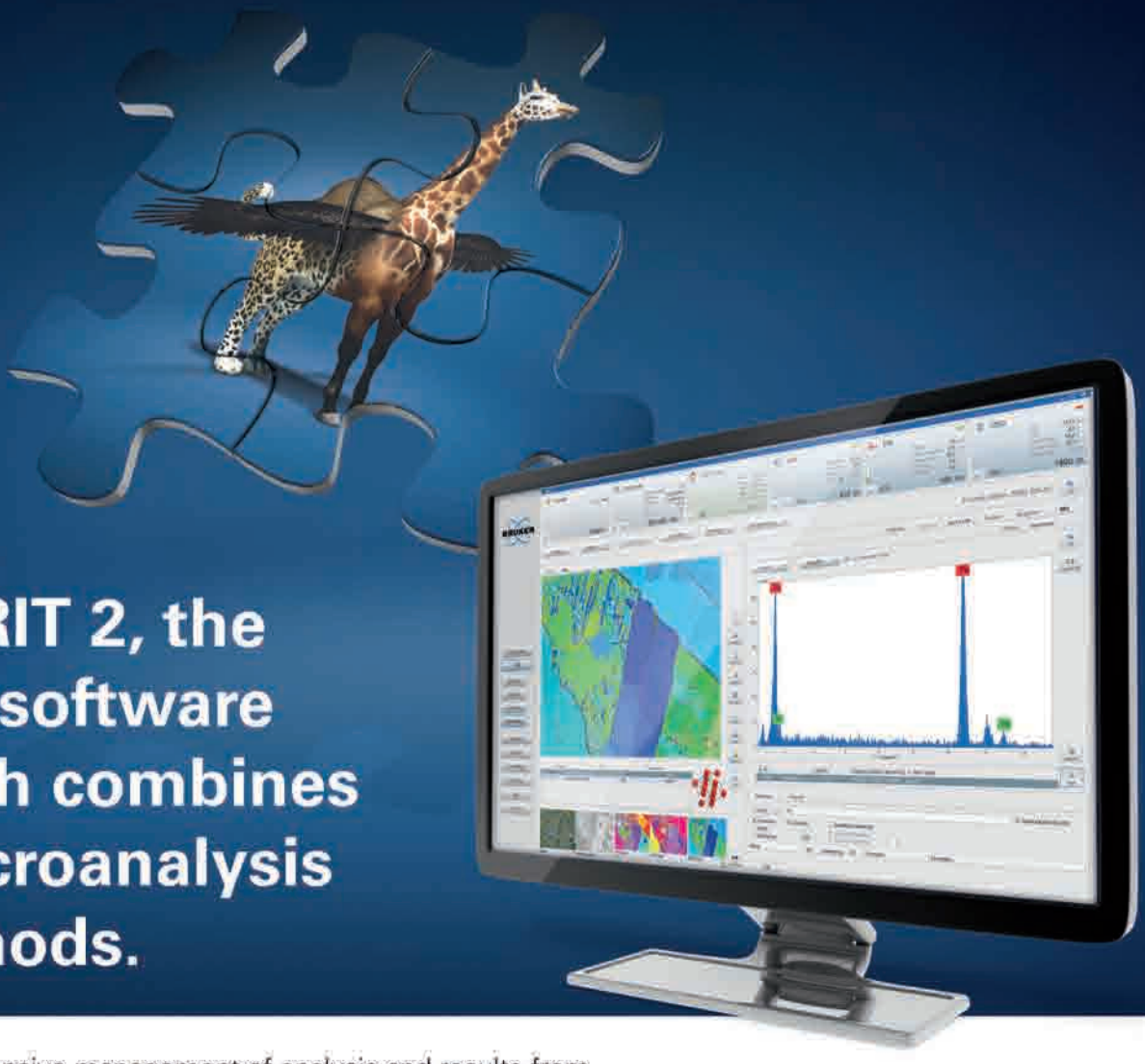

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2015 EMS EXTENSION REPORTS

MCM2015, Eger, Hungary

Following a tight competition among the Croatian, Serbian and Hungarian bids the Hungarian Society for Microscopy gained the possibility to host the next, in order the 12th Multinational Congress on Microscopy event, during the MC2013 held in Regensburg in 2013. We suggested Eger, a small town with famous history, located on the north-eastern part of Hungary as venue and the Hotel Eger&Park equipped with lecture halls, meeting rooms and convenient space for exhibitions as head-quarter of the conference.
At the IMC2014 in Prague, we also got the support of EMS, which fact was immediately proudly indicated on the MCM2015 web site: EMS Extension 2015. We did not hesitate to invite two excellent scientists as 'EMS lecturers' and were lucky that both of them, namely Rafal E. Dunin-Borkowski (Jülich, Germany) and Toyoshi Fujimoto (Nagoya, Japan) accepted the invitation right away.

Organizing a good program is never easy, and for an MCM meeting it has an extra challenge because the host society is expected to arrange everything in harmony with the microscopic societies of all MCM countries, in alphabetical order: Austria, Croatia, Czech Republic, Hungary, Italy, Serbia, Slovenia, Slovakia and Turkey. Fortunately, the presidents and/or secretaries of the societies, especially our Italian, Austrian and Czech colleagues who organized similar events in the last years were very helpful. The same applies to our newly joined Turkish colleagues who always lent a hand in case of a problem arisen.

We had a board meeting in Prague to set the main points, selection of plenary and invited lecturers and evaluation of submitted papers were done mainly through the Internet.

Besides seven plenary lectures we had 45 invited talks and 84 short talks in the 3 parallel sections (Life Sciences, Material Sciences, Instrumentation and Techniques) and 192 posters were exhibited from Monday till Friday morning. We had an impressive list of plenary speakers, just to mention Péter Somogyi, the winner of the first Brain Prize, and two ERC grant recipients (Iva Tolic and Rafal E. Dunin-Borkowski). The subjects of the lectures covered a wide range from the results achieved on the field of neuroscience by classical electron microscopic techniques (Peter Somogyi) to single-molecule imaging of a motor protein in vivo, presented in a dynamic lecture by Iva Tolic, or from high resolution microscopy and spectroscopy (Velimir R. Radmilovi) to electromagnetic field mapping showed by Rafal E. Dunin-Borkowski. All plenary lectures were followed by lively discussions.

The conference program also involved 6 lunch workshops hosted by our main sponsors (FEI, JEOL, 3DHistech and also partners Gatan, Leica, NanoMEGAs SPRL) which were popular among the conference participants.
And it was not all! At midday on Thursday many of the conference participants, old friends and colleagues from the MCM countries attended a special event to celebrate the 90 years old Professor Dezs Szabó, an excellent microscopist, one of the pioneers of the Hungarian electron microscopy and founder of the Hungarian Microscopic Society as well as his friend and colleague from the field of materials sciences, Professor Péter B. Barna, laureate of the R.F. Bunshah Award handed over this year in San Diego, USA. "Electron microscopists are beautiful people"- as a very old slogan billed on an old JEOL poster. And if we mention the word "beautiful", the Best Picture Awards was handed over for the three best micrographs during this event. The nice prizes (Nikon cameras) were given by the Auro-Science Consulting Ltd.

The program contained special possibility for the youngest conference attendees, from undergraduates till young post docs. The "Open discussion between speakers and young scientists (with snacks & drinks)" was held on Thursday afternoon and thanks to our enthusiastic lecturers who immediately agreed to participate and Viktor Kis (just before the PhD) for his organization efforts, many young

scientists attended this event and could enjoy interesting and hopefully useful conversations with experienced and successful scientists.
As it is usual at an international conference, some board meetings were also held, such as the MCM Board meeting where we had to decide on the venue of the next conference, SISM board meeting and assembly, and EMS board meeting and general assembly. Our guests were EMS president Roger Wepf, secretary Nick Schryvers, treasurer Christian Schöfer, board member Pavel Hozak – just to mention few. We could hear about the achievements of EMC2016, Lyon, too, from Thierry Epicier, the chair of this conference who was invited by our organizing company, AKCongress.

Naturally, social programs were also offered for the attendees and their family members. On Sunday evening good food and living music helped the relaxed atmosphere of the Welcome reception following the short Opening ceremony started with the 'MCM suite' composed and performed by the Góbé band. During this music journey every participant of an MCM country could recognize popular melodies of his/her homeland. On Wednesday many of us visited the famous National Park Hortobágy, while others selected the free guided city tours which were really good programs in the fine summer afternoon. It is not our merit, but we had excellent weather, too. One of Eger's most distinguished wineries, the Bolyki Winery was the venue of the gala dinner. Since not everybody selected this program, the Best Posters Awards (altogether 12) and Best Young Lecturer Awards (one-one in Life and Material Sciences as well as Instrumentation and Technology) were announced and handed over at the Closing Ceremony on Friday.

In our bid we promised to keep the registration fee as low as possible (early bird reg. fee for EMS member PhD students was only 80 EUR and for EMS member 180 EUR) and thanks to the generosity of our exhibitors whose number exceeded our expectations (26 companies and firms!, and the active work of the members of our organizing company, AKCongress, led by Erna Sári following Edina Bojtosné Barabás, we could keep our word. High number of PhD students were supported by the grants of the MCM countries, too.

Perhaps this report could indicate that our conference became larger than we dared to expect. Instead of the hoped 300-350 participants we were altogether 474. Attendees arrived even from Africa (12), North and South-America (9) and 45 from Asia! The interest was pretty high and likely only the difficulties with visa and lack of more financial support prevented more participants from these far places.

We hope, Eger, which is the third most visited locality in our country, famous about its baroque town center, wine and bathing culture, its beautiful surroundings and respectable history, could add our meeting to this impressive list.
Thanks everybody for visiting our conference and making it scientifically valuable and socially rich.

See you all at the next MCM event hosted by the Croatian Microscopy Society and held in Rovinj, Croatia in 2017!

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LS4 Membrane interaction
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LS6 Micro-organism / host interactions
LS7 Organism development and imaging
LS8 Human health and disease
LS9 Societal challenges and environment

INSTRUMENTATION AND METHODS (IM)

IM1 Tomography and Multidimensional microscopy
IM2 Micro-Nano Lab and dynamic microscopy
IM3 New Instrumentation
IM4 Non linear and vibrational microscopy and new contrasts
IM5 Quantitative imaging and image processing
IM6 Quantitative diffraction
IM7 Phase microscopies
IM8 Spectromicroscopies and analytical microscopy (electrons and photons, experiment and theory)
IM9 Super resolution in light microscopy
IM10 Correlative microscopy

MATERIALS SCIENCES

MS0 Nanoparticles: from synthesis to applications
MS1 Structural materials, defects and phase transformations
MS2 1D and 2D materials
MS3 Semiconductors and devices
MS4 Complex materials and nanocomposites
MS5 Energy-related materials
MS6 Oxide-based, magnetic and other functional materials and applications
MS7 Materials for optics and nano-optics
MS8 Geology and mineralogy, cultural heritage and archeology

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Microscience Microscopy Congress
incorporating EMAG

Microscience Microscopy Congress 2015 - the very best in microscopy

Between Monday 29 June and Thursday 2 July, over 1800 people flocked to Manchester to see the latest and greatest in microscopy research and equipment. mmc2015 incorporating EMAG was organised by the Royal Microscopical Society and was one of the 2 EMS Extensions for 2015. This year the popular EMAG meeting, from the Electron Microscopy and Analysis Group of the Institute of Physics, was incorporated into the programme for the first time, joining the SPM, Frontiers in Bioimaging, FIB and EM Prep and Focus on Food Meetings to add a huge range and diversity both to the scientific conference and the huge exhibition.

mmc2015 got off to a busy start with 5 pre-congress workshops on Monday 29 June covering ImageJ, EELS, AFM, Light Sheet Microscopy and OMERO. The ImageJ workshop was fully booked early on in pre-registration, and proved to be a popular theme throughout. These were followed by Plenary Lectures from Professor Jackie Hunter of the BBSRC and EMS and EMAG Plenary Speaker Professor Dirk van Dyck from the University of Antwerp which proved to be incredibly popular with standing room only!

Tuesday 30 June began with a Plenary Lecture from the second EMS Plenary Speaker, Professor Petra Schwille, followed by the opening of the huge exhibition, the display of over 125 posters in the first of two poster sessions and the beginning of six parallel conference sessions covering a huge array of microscopy topics. The 4 commercial workshops throughout the exhibition hall welcomed a number of visitors keen to hear more from industry experts covering subjects such as carbon coating, choosing a camera and Imaris8. The RMS Learning Zone also welcomed those wishing to learn more about a specific discipline in a relaxed, informal environment with SEM, TEM, LM, SPM, Specimen Preparation, Confocal and Digital Microscopy all covered. mmc2015 ran on into the evening with a popular poster session and meeting specific dinners taking place in restaurants around Manchester, to enable more focussed networking.

Wednesday 1 July welcomed in the new month with another day of the mmc2015 conference and exhibition, starting with a Plenary Lecture from Professor Sir Colin Humphreys CBE. This day saw the second set of posters available to view and more commercial workshops on topics such as 3D AFM tomography, EBSD resolution and real time super resolution image acquisition. The first ever meeting of EM-UK: the new network for the electron microscopy community in the UK, took place in the morning. This meeting was well attended and there was plenty of

discussion on future plans, including organising a Facility Managers meeting later in the year. Wednesday lunchtime marked the announcement of the winners of the RMS Scientific Imaging Competition. Selected from over 250 entries, these winners represented both the technical challenge of obtaining the image as well as its aesthetics. From 7pm, attendees hopped across the road to the Midland Hotel for the Congress Banquet where dinner, drinks and dancing all ensued, ensuring a great evening for all.

The Banquet opened with speeches and the presentation of the EMS Outstanding Paper Awards for 2014 to Maryam Khoshouei, Sharon G Wolf and Reza Zamani. Congratulations again to all three! Details of their papers and links to read them can be found at the end of this article.

Thursday 2 July was the third and final day of the exhibition and the conference sessions with both EMAG and mmc2015 wrapping up. EMAG 2015 finished with a closing lecture from Dr Max Haider. The Commercial Workshops and the Learning Zone still attracted visitors to the various drop-in talks that were taking place throughout the day. Once the exhibition closed at 3pm, poster prizes were announced and awarded followed by a closing mmc2015 Plenary Lecture from Professor Xiaowei Zhuang of Harvard University.

The RMS would like to thank the European Microscopy Society for their support of mmc2015 and are proud that the event was recognised as an EMS Extension.

By incorporating so many popular meetings, mmc2015 allowed a huge number of delegates from a wide range of disciplines and industries to meet together. With so many communities under one roof, we had over 700 conference delegates – the highest number ever in MICROSCIENCE history!

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EMS Jury Chair Professor Rik Brydson presents Maryam Khoshouei with her EMS Outstanding Paper Award

EMS Outstanding Paper Awards

Instrumentation and Technique Development

Maryam Khoshouei

'Volta potential phase plate for in-focus phase contrast transmission electron microscopy'

R. Danev, B. Buijsse, M. Khoshouei, J. M. Plitzko and W. Baumeister; Proc. Natl. Acad. Sci. 111, 15635-15640 (2014);
doi: 10.1073/pnas.1418377111

Life Sciences

Sharon G Wolf

'Cryo-scanning transmission electron tomography of vitrified cells'

S. Grayer Wolf, L. Houben and M. Elbaum; Nature Methods 11, 423-428 (2014);
doi:10.1038/nmeth.2842

Materials Sciences

Reza Zamani

'Polarity-Driven Polytypic Branching in Cu-Based Quaternary Chalcogenide Nanostructures'

R. R. Zamani, M. Ibáñez, M. Luysberg, N. Garcia-Castelló, L. Houben, J.D. Prades, V. Grillo, R. E. Dunin-Borkowski, J. Ramón Morante, A. Cabot and J. Arbiol; ACS Nano 8, 2290–2301 (2014);
doi: 10.1021/nn405747h

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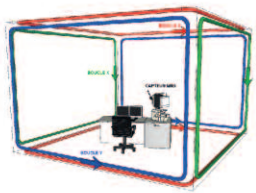

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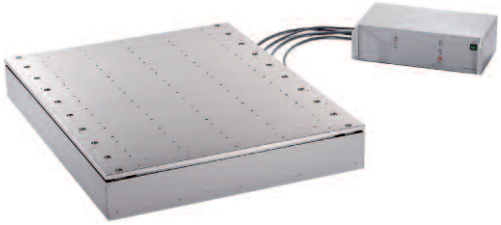
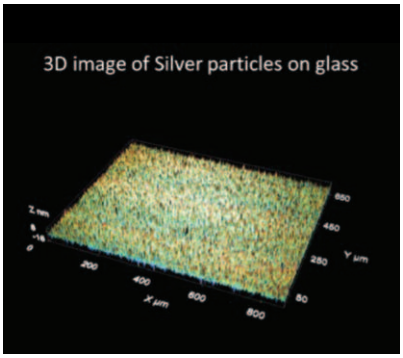
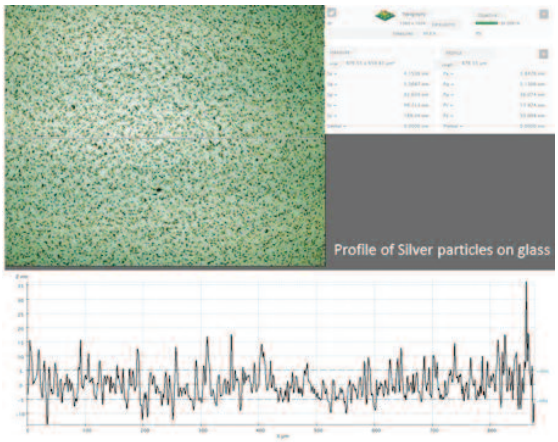


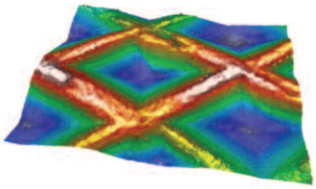
Active vibration isolation platform for SEM

EMS LECTURE PAPERS AT MCM2015 IN EGER, HUNGARY

SENSOFAR "Sneox" 3D optical profiler : the best of the newest surface metrology techniques



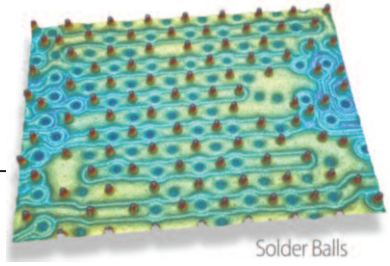


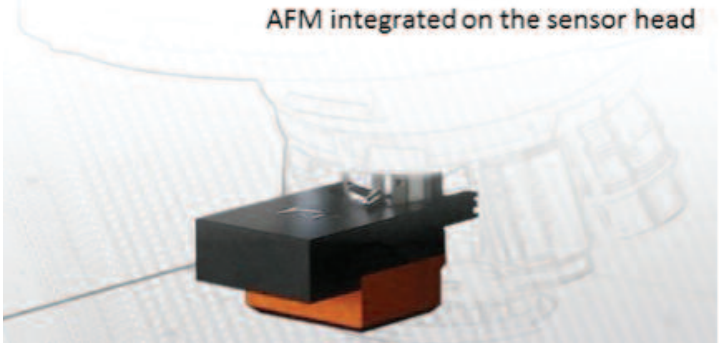


The latest 3D optical profiler of the company SENSOFAR, the S neox, is one of the most interesting instruments officially distributed by the Schaefer group. It combines, in the same sensor head, confocal, interferometry (VSI, PSI) and focus variation techniques without any moving parts, achieving vertical and lateral resolutions of 0.01 nm and 0.1 µm respectively. An Atomic Force Microscope can be used instead of a normal objective lens extending the resolution and measuring capabilities of the profiler.

In addition, it is possible to perform thickness measurements of transparent thin and thick films with the integration of a spectroscopic reflectometer coupled through an optical fiber. Coatings from 50 nm up to 20 µm can be measured in less than one second with a thickness resolution of 0.1 nm and a lateral resolution up to 5 µm; the system can measure a stack of up to 10 layers.

The newest technology introduced in the Sneox is the "Focus Variation" developed for the measurement of the shape of large rough surfaces and is designed to complement confocal measurements at low magnification. Highlights of the technology include high slope surfaces (up to 86°), highest measurement speeds (mm/s) and large vertical range. This combination of measurement capabilities is mainly used for tooling applications.





LOOKING AT THE NANO-LEVEL MEMBRANE LIPID DISTRIBUTION BY ELECTRON MICROSCOPY

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Keywords: *glycolipid, phospholipid, phosphoinositide, freeze-fracture, quick-freezing, electron microscopy*

A. Introduction

Biological membranes are two-dimensional dynamic structures. Lipids provide the structural basis and multiple functionalities to the membrane, but information on lipid distribution in the membrane is relatively scarce in comparison to protein distribution. This is mainly because methods used to observe distribution of proteins cannot be directly applied to lipids. Thus, even though specific probes are available for many membrane lipids, it is difficult to define their distribution at the nanometer scale.

A major problem in defining distribution of lipids at such a small scale is that aldehyde fixatives do not work on most lipids (Takatori et al., 2014). One might think that the invention of a chemical fixative that reacts with lipids would solve the problem, but this is not likely because lipids diffuse very quickly in the membrane. For example, the diffusion coefficient of phosphatidylcholine in the liposomal membrane was reported to be in the range of 10^{-7} to 10^{-8} cm^2/sec (Wu et al., 1977). If we suppose that the diffusion coefficient is 4×10^{-8} cm^2/sec, phosphatidylcholine would be able to move 4 m in 1 sec, and 1.3 m in 0.1 sec. It is not likely that the reaction with a dream fixative would be completed within a much shorter time than 0.1 sec, by which time phosphatidylcholine could have moved more than 1 m. These considerations led us to think that chemical fixation is not an appropriate method to use when defining the nanoscale distribution of lipids. (Because proteins generally diffuse at a much slower rate than lipids, chemical fixation is less likely to cause problems in this case. Nevertheless it should be noted that proteins can move more then 0.1 m in 1 sec.)

B. Quick-freezing and freeze-fracture replica labelling method

We think that quick-freezing is the only practical way to capture lipids *in situ* and that methods other than chemical fixation are needed to immobilize lipids on the spot during subsequent treatments. Thus we came to use the combination of quick-freezing and freeze-fracture replica formation to observe the distribution of lipids (Fujita et al., 2010). First, by quick-freezing, the movement of molecules is halted instantaneously. Two different methods for quick-freezing, i.e., metal contact freezing and high-pressure freezing, can freeze specimens within 0.1–1 msec (J. Heuser, personal communication), and within roughly 30 msec (Kiss and Staehelin, 1995), respectively. Second, freeze-fracturing splits a membrane into two leaflets, and the vacuum evaporation of carbon and platinum coats the exposed hydrophobic surface of the leaflets with thin layers, thus holding the structure of a membrane leaflet in a stable state. The resulting preparation is called the freeze-fracture replica, and molecules captured within the replica can be labelled or treated with various chemicals to maintain the original molecular distribution (Fujimoto, 1995; Fujimoto et al., 1996). We call the entire procedure the quick-freezing and freeze-fracture replica labelling method, or QF-FRL (Fig. 1).

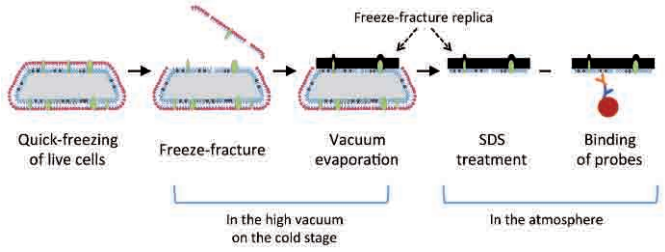

Fig. 1. The outline of the QF-FRL method. Please note that the membrane leaflet is physically stabilized by the freeze-fracture replica, or layers of carbon and platinum formed by vacuum evaporation.

C. Two-dimensional distribution of membrane lipids

We have been analysing the two-dimensional and three-dimensional (i.e., asymmetrical) distribution of membrane lipids through the use of QF-FRL. With regards to the two-dimensional aspect, we used the method to define the distribution of lipids that were assumed to constitute lipid rafts. The raft was hypothesized to form based on the property of sphingolipids and cholesterol (Simons and Ikonen, 1997), which are known to generate the liquid-ordered (Lo) domain in liposomes. The Lo domain in liposomes can be isolated biochemically as a membrane that is resistant to solubilisation with nonionic detergents, i.e., the detergent-resistant membrane (DRM). Because DRM can be obtained

from cells by the same method and was found to have a similar lipid composition as the Lo domain of liposomes, it was often treated as an in vitro correlate of the raft (Brown, 2006). But whether lipids found in DRM make distinct domains in cells could not be determined by microscopy.

To undertake this problem we used QF-FRL to examine the nano-scale distribution of three lipids enriched in DRM. Those lipids were gangliosides GM1 and GM3, and phosphatidylinositol 4,5-bisphosphate [PtdIns(4,5)P_2], and it was confirmed that they could be specifically labelled by the use of anti-GM1 antibody, anti-GM3 antibody (Fujita et al., 2007), and GST-fused pleckstrin homology domain of phospholipase C (PLC) 1 (GST-PLC 1-PH) (Fujita et al., 2009b), respectively. For GM1 and GM3, double labeling was also performed.

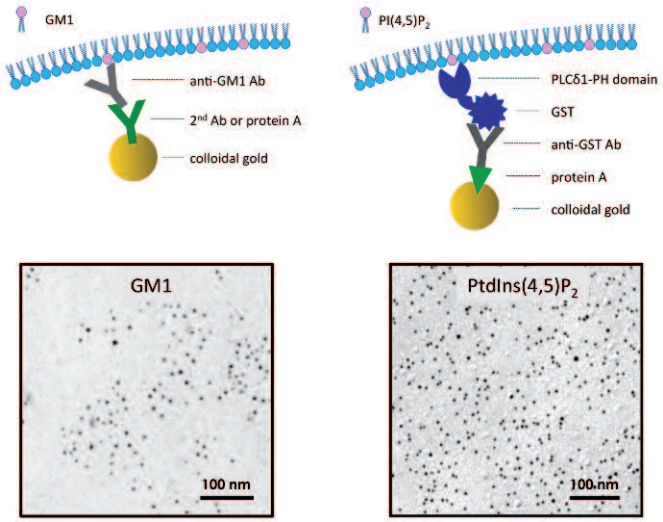

Fig. 2. Distribution of GM1 and PtdIns(4,5)P2 in the flat undifferentiated area of the plasma membrane (modified from Fujita et al, 2007 and Fujita et al, 2009, respectively). The diagram shows the combination of probes used to label the lipids.

The results obtained were as follows:

1) GM1 was clustered in the plasma membrane of untreated cells (Fig. 2), and the degree of clustering was decreased significantly when cells were treated with methyl- -cytodextrin to reduce the cholesterol content. GM3 also distributed in clusters, which were also decreased by cholesterol depletion (Fujita et al., 2007).
2) GM1 and GM3 seldom made co-clusters but were segregated from each other in untreated cells. When actin was depolymerized by latrunculin A, GM1 and GM3 showed significant co-clustering (Fujita et al., 2009a).
3) PtdIns(4,5)P_2 did not show significant clustering in the undifferentiated flat area of the plasma membrane (Fig. 2), but was markedly concentrated at the orifice of caveolae (Fujita et al., 2009b). These results revealed that lipids recovered in DRM do not necessarily co-distribute or make clusters in living cells, thus indicating that distribution of the lipids is not determined only by the properties of lipids themselves, but is also affected by proteins, such as actin and caveolins.

D. Three-dimensional distribution of phospholipids

It is well-known that phospholipids existing in the inner and outer leaflets of the human red blood cell (RBC) membrane are divergent (Bretscher, 1972). This phospholipid asymmetry seen in the RBC membrane is sometimes considered to be the prototype of all membranes, and phosphatidylserine is actually confined to the inner leaflet of the plasma membrane in many eukaryotic cells. However, whether phospholipids other than phosphatidylserine take a similar distribution pattern to that of the RBC membrane is not necessarily clear. Information on the distribution of phospholipids in intracellular organelle membranes is even more limited than that of the plasma membrane (Op den Kamp, 1979 ; Zachowski, 1993).

Freeze-fracture electron microscopy is a powerful tool to study membrane asymmetry, because the two leaflets can be distinguished clearly. This contrasts with methods using ultrathin sections, in which the two leaflets are recognized only as two parallel lines that are less than 5 nm apart. Taking the above advantage of freeze-fracturing, we studied the distribution of several phospholipids, such as choline-containing phospholipids, which are phosphatidylcholine (PC) and lysophosphatidylcholine in yeast. Because the labelling efficiency of anti-PC antibody was not satisfactory, we used propargylcholine, a choline analogue with an alkyne residue (Jao et al., 2009), and detected it by use of click chemistry. That is, the alkyne group incorporated to the head group of PC and lyso-PC was conjugated with biotin-azide by applying click chemistry to the replica and labelling it by anti-biotin antibody (Iyoshi et al., 2014). The results showed that choline-containing phospholipids distribute in equivalent densities in the two leaflets in most intracellular organelle membranes, but they showed a slight asymmetry in the Golgi and were highly biased to the cytoplasmic leaflet in the plasma membrane.

The result in the plasma membrane was different from that in mammalian cells, in which the label was found in a similar density in the two leaflets.

Phosphatidylinositol 3-phosphate [PtdIns(3)P], a phosphoinositide indispensable for autophagy, was another example of unexpected membrane asymmetry revealed by QF-FRL. Phosphoinositides are known to have many functionalities in the cytoplasmic side of various membranes, and consistently, PtdIns(3)P was observed in the cytoplasmic side of autophagosomes. QF-FRL confirmed the result, but additionally, it showed that PtdIns(3)P in the yeast autophagosome distributes much more abundantly in the luminal leaflet, or the leaflet facing the closed compartment bound with two autophagosomal membranes, than in the cytoplasmic leaflet (Cheng et al., 2014) (Fig. 3). The physiological significance of PtdIns(3)P in the luminal leaflet is yet to be explored, and QF-FRL should prove to be an indispensable method for the study, because no other method is likely to unambiguously show the presence of PtdIns(3)P in such locations.

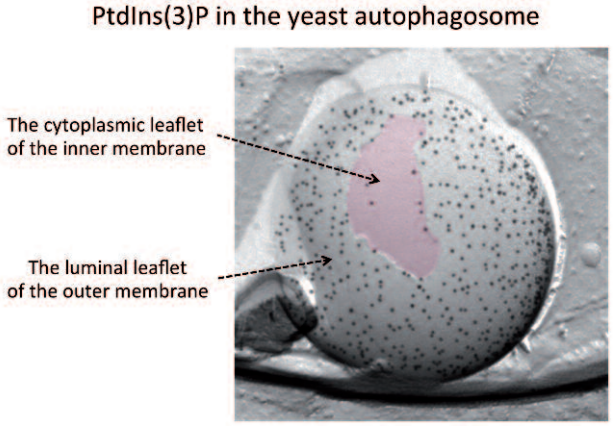

Fig. 3. Distribution of PtdIns(3)P in the yeast autophagosome. Please note that the luminal leaflet of the outer membrane is densely labeled for PtdIns(3)P.

E. Perspectives

Freeze-fracturing is a classical EM technique that was established in the 1960's. It had been used as a method for purely morphological observation, but pioneering works by Dr. Pedro Pinto da Silva and Dr. Kazushi Fujimoto showed that a membrane leaflet is retained securely in the freeze-fracture replica (da Silva et al., 1989) and can be labelled by various probes (Fujimoto, 1995; Fujimoto et al., 1996).

We believe that freeze-fracturing combined with quick-freezing is one of a very limited number of methods that can preserve the *in situ* distribution of molecules for microscopy. Its application is not limited only to histochemical labelling, but can be extended to other techniques that require a membrane preparation in a stable form. Unfortunately, however, not many researchers are capable using, or are even familiar with, this method at present. We hope that the potential of this method will be understood and subsequently fully utilized by researchers from a wide variety of disciplines.

References

- Bretscher, M.S. 1972. Asymmetrical lipid bilayer structure for biological membranes. *Nat New Biol*. 236:11-12.
- Brown, D.A. 2006. Lipid rafts, detergent-resistant membranes, and raft targeting signals. *Physiology (Bethesda)*. 21:430-439.
- Cheng, J., A. Fujita, H. Yamamoto, T. Tatematsu, S. Kakuta, K. Obara, Y. Ohsumi, and T. Fujimoto. 2014. Yeast and mammalian autophagosomes exhibit distinct phosphatidylinositol 3-phosphate asymmetries. *Nat Commun*. 5:3207.
- da Silva, P.P., C.A. Forsman, and K. Fujimoto. 1989. Fracture-flip: nanoanatomy and topochemistry of cell surfaces. *Prog Clin Biol Res*. 295:49-56.
- Fujimoto, K. 1995. Freeze-fracture replica electron microscopy combined with SDS digestion for cytochemical labeling of integral membrane proteins. Application to the immunogold labeling of intercellular junctional complexes. *J Cell Sci*. 108:3443-3449.
- Fujimoto, K., M. Umeda, and T. Fujimoto. 1996. Transmembrane phospholipid distribution revealed by freeze-fracture replica labeling. *J Cell Sci*. 109:2453-2460.
- Fujita, A., J. Cheng, and T. Fujimoto. 2009a. Segregation of GM1 and GM3 clusters in the cell membrane depends on the intact actin cytoskeleton. *Biochim Biophys Acta*. 1791:388-396.
- Fujita, A., J. Cheng, and T. Fujimoto. 2010. Quantitative electron microscopy for the nanoscale analysis of membrane lipid distribution. *Nat Protoc*. 5:661-669.
- Fujita, A., J. Cheng, M. Hirakawa, K. Furukawa, S. Kusunoki, and T. Fujimoto. 2007. Gangliosides GM1 and GM3 in the living cell membrane form clusters susceptible to cholesterol depletion and chilling. *Mol Biol Cell*. 18:2112-2122.
- Fujita, A., J. Cheng, K. Tauchi-Sato, T. Takenawa, and T. Fujimoto. 2009b. A distinct pool of phosphatidylinositol 4,5-bisphosphate in caveolae revealed by a nanoscale labeling technique. *Proc Natl Acad Sci U S A*. 106:9256-9261.
- Iyoshi, S., J. Cheng, T. Tatematsu, S. Takatori, M. Taki, Y. Yamamoto, A. Salic, and T. Fujimoto. 2014. Asymmetrical distribution of choline phospholipids revealed by click chemistry and freeze-fracture electron microscopy. *ACS Chem Biol*. 9:2217-2222.
- Jao, C.Y., M. Roth, R. Welti, and A. Salic. 2009. Metabolic labeling and direct imaging of choline phospholipids in vivo. *Proc Natl Acad Sci U S A*. 106:15332-15337.
- Kiss, J.Z., and A. Staehelin. 1995. High pressure freezing. *In* Rapid Freezing, Freeze Fracture, and Deep Etching. N.J. Severs and D.M. Shotton, editors. Wiley-Liss, New York. 89-104.
- Op den Kamp, J.A. 1979. Lipid asymmetry in membranes. *Annu Rev Biochem*. 48:47-71.
- Simons, K., and E. Ikonen. 1997. Functional rafts in cell membranes. *Nature*. 387:569-572.
- Takatori, S., R. Mesman, and T. Fujimoto. 2014. Microscopic methods to observe the distribution of lipids in the cellular membrane. *Biochemistry*. 53:639-653.
- Wu, E.S., K. Jacobson, and D. Papahadjopoulos. 1977. Lateral diffusion in phospholipid multibilayers measured by fluorescence recovery after photobleaching. *Biochemistry*. 16:3936-3941.
- Zachowski, A. 1993. Phospholipids in animal eukaryotic membranes: transverse asymmetry and movement. *Biochem J.* 294:1-14.

OFF-AXIS ELECTRON HOLOGRAPHY

Off-axis electron holography of electromagnetic fields in nanoscale materials and devices in the presence of external stimuli

Introduction

The technique of off-axis electron holography involves the formation of an interference pattern or 'hologram' in the transmission electron microscope (TEM). In contrast to most conventional TEM techniques, which only allow the spatial distribution of image intensity to be recorded, off-axis electron holography also allows the phase shift of the high-energy electron wave that has passed through a specimen to be measured directly. The phase shift can, in turn, be used to provide information about local variations in magnetic induction and electrostatic potential within and around the specimen [1, 2].

The basis of the TEM mode off-axis electron holography is described schematically in Fig. 1. The region of interest in the specimen is positioned so that it covers approximately half the field of view. The application of a voltage to an electron biprism results in overlap of a 'reference' electron wave that has passed through vacuum with the electron wave that has passed through the specimen. If the electron source is sufficiently coherent, then an interference fringe pattern (an electron hologram) is formed in the overlap region, superimposed on an image of the specimen. The amplitude and phase shift of the specimen wave are recorded in the intensity and the position, respectively, of the interference fringes and can be reconstructed from each hologram digitally using a standard fast Fourier-transform-based method [3]. For studies of magnetic materials, a Lorentz lens (a high-strength minilens) allows the microscope to be operated at high magnification with the conventional objective lens switched off and the sample in magnetic-field-free conditions.

As phase information is stored in the lateral displacement of the holographic interference fringes, long-range phase modulations arising from inhomogeneities in the charge and the thickness of the biprism wire, as well as from lens distortions and charging effects (e.g., at apertures) can introduce artefacts. In order to take these effects into account, a reference hologram is usually obtained from vacuum alone by removing the specimen from the field of view without changing the optical parameters of the microscope. Correction is then possible by performing a complex division of the recovered specimen and vacuum wavefunctions in real space and then calculating the phase (the arctangent of the ratio of the imaginary and real parts) of the resulting complex wavefunction, to obtain a distortion-free phase image.

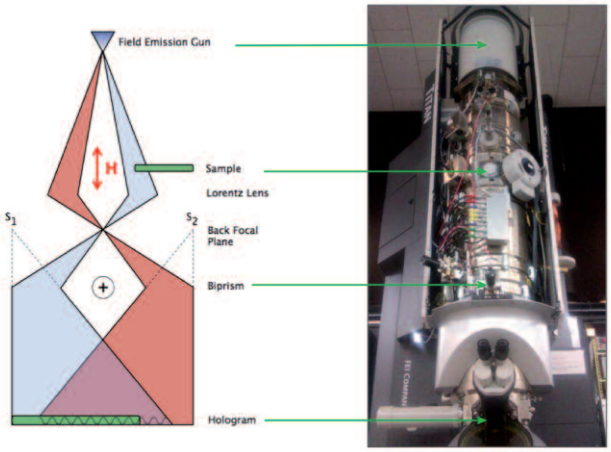

Fig. 1. Schematic diagram of the set-up used for generating off-axis electron holograms (left), shown alongside a photograph of an FEI Titan TEM (right). For off-axis electron holography, the sample occupies approximately half the field of view. Essential components in the microscope are the field emission gun electron source (which provides coherent illumination) and the electron biprism (which causes overlap of the sample and vacuum reference waves). The biprism is usually a wire, below 1 μm in diameter, located in place of one of the conventional selected-area apertures. The sample and reference waves can be considered as originating from two virtual sources S1 and S2. The Lorentz lens allows imaging of magnetic materials in close-to-magnetic-field-free conditions. The conventional electron microscope objective lens can be used to apply a vertical magnetic field H to the sample, which can then be tilted in this field in order to study magnetization reversal processes in the specimen *in situ* in the TEM.

A final recorded phase image can be used to measure the electrostatic potential and the in-plane component of the magnetic induction in the specimen. Neglecting the effects of dynamical diffraction (i.e., assuming that the specimen is thin and weakly diffracting), the phase can be expressed (in one dimension for simplicity here) in the form

$$\phi(x) = C_E \int V(x,z)dz - \left(\frac{e}{\hbar}\right) \iint B_\perp(x,z)dxdz\,, \quad [1]$$

where x is a direction in the plane of the specimen, z is the incident electron beam direction, V is the electrostatic potential, the constant CE takes values of 7.29×10^6 and 6.53×10^6 rad V^{-1} m^{-1} at accelerating voltages of 200 and 300 kV, respectively and $B_\perp$ is the component of the magnetic induction perpendicular to both x and z. If neither $V_\perp$ nor $B_\perp$ varies along the electron beam direction in a specimen of thickness t and there are no electromagnetic

fringing fields outside the specimen, then Eq. 1 can be simplified to

$$\phi(x) = C_E V(x) t(x) - \left(\frac{e}{\hbar}\right) \int B_\perp(x)\, t(x) dx \,. \qquad [2]$$

By making use of Eqs. 1 and 2, high spatial resolution information about local variations in $V_\perp$ and $B_\perp$ can be recovered from a measured phase image.

Off-axis electron holography is now routinely applied to the characterization of magnetic fields both within and around nanoscale crystals [e.g., 4, 5] and to the characterization of electrostatic potentials in doped semiconductor devices [e.g., 6, 7]. Recent developments in the technique have included the use of advanced specimen holders with multiple electrical contacts to study working nanoscale devices [e.g., 8, 9] and the use of ultra-stable transmission electron microscopes to achieve improved (sub-2π/1000-radian) phase sensitivity [10].

Here, we briefly review a selection of recent applications of medium-resolution off-axis electron holography to quantitative studies of electromagnetic fields in nanoscale materials and devices that are examined at elevated temperature, in the presence of a gas environment and under an applied electrical voltage *in situ* in the TEM. Each example illustrates the way in which experimental procedures need to be adapted when performing *in situ* studies to ensure that possible artefacts are eliminated from the results.

Magnetite grains at elevated temperature

Fig. 2 shows a selection of results obtained using off-axis electron holography from an *in situ* study of the thermomagnetic behaviour of nanoscale grains of magnetite (Fe_3O_4) in a synthetic basalt sample. The sample was synthesized by a glass-ceramic method from powders of Fe_2O_3, SiO_2, $CaCO_3$, K_2CO_3, and Na_2CO_3. The Fe_3O_4 grains in the final specimen are separated from each other in a glass ceramic matrix and range in size from ~50 to ~500 nm. Bulk magnetic measurements indicated that the sample contains a mixture of single domain and pseudo-single-domain grains, has a Curie temperature of 585 ± 5 °C and shows a significant drop in magnetisation above 400 °C [11].

TEM specimens were prepared directly on double-tilt heating chips, before being ion-milled into thin sections. Off-axis electron holograms were acquired using an FEI Titan 80-300 TEM operated in Lorentz mode. A bright-field TEM image of a representative Fe_3O_4 grain is shown in Fig. 2. The grain has a square toroidal morphology with dimensions of ~300 nm on each side. Fig. 2b-2d show magnetic induction maps recorded from the same grain at remanence (in magnetic-field-free conditions) using off-axis electron holography as the specimen was heated successively to temperatures of 400, 500 and 550 °C *in situ* in the TEM. Unexpectedly, it became apparent that great care was required to ensure that the electrostatic contribution to the phase shift was subtracted correctly at each specimen temperature, primarily because of the effects of temperature-dependent electron-beam-induced specimen charging. As a result, the direction of magnetisation in the specimen was reversed at each temperature *in situ* in the TEM by tilting the specimen to ± 75° and turning on the conventional microscope objective lens to apply a magnetic field of ~1.5 T parallel to the direction of the electron beam. The objective lens was then turned off and the specimen tilted back to 0° for hologram acquisition in field-free conditions with the particles at remanence. The magnetic contribution to the phase was subsequently determined by taking half of the difference between phase images between which the magnetization direction in the region of interest had reversed exactly.

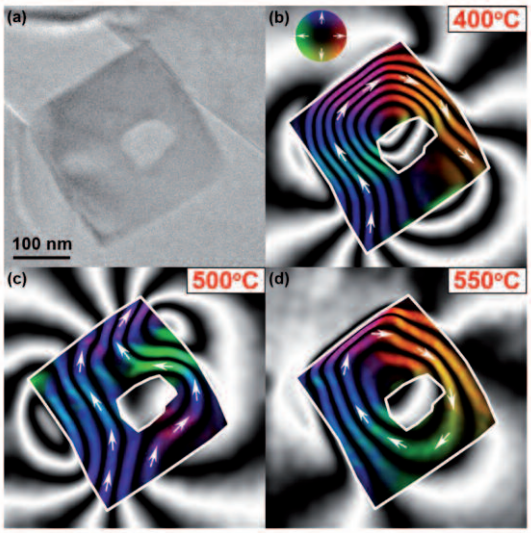

Fig. 2. (a) Bright-field TEM image of a 300 nm magnetite (Fe_3O_4) grain that has a square toroidal morphology and is embedded in a silicate matrix.
Fig. 2. (b-d) Magnetic induction maps obtained using off-axis electron holography from the magnetite grain during *in situ* heating to (b) 400,
Fig. 2. (c) 500 and (d) 550°C. The outline of the grain is marked using solid white lines. The phase contour spacing is 0.39 radians. The direction of the measured magnetic induction is shown using arrows and colours, as depicted in the colour wheel. Reprinted from Ref. 11.

Interestingly, the magnetic induction map recorded at 400 °C (Fig. 2b) shows a horseshoe-like state, with the measured magnetic field flowing in a clockwise direction. An increase in temperature to 500 °C (Fig. 2c) then results in a significant change in the measured magnetic field, with the contours now flowing from the bottom to top of the grain, as well as exhibiting a prominent stray magnetic field. The magnetic field is observed to curve around the right of the hole, before re-joining the contours in the left of the grain. At 550 °C, the magnetic field is now observed to close into a vortex-like structure around the hole (Fig. 2d), along with a reduced stray magnetic field. The three magnetic states shown in Fig. 2 are therefore all markedly different from each other. The magnetic induction maps provide a direct quantitative representation of the variation in remanent magnetisation within an individual magnetite grain as a function of temperature. The results provide insight into the role of the effect of temperature on the acquisition of a magnetic signal from the geomagnetic field as such grains cool below their Curie temperature. In the case of metamorphic rocks, which experience multiple heatings, a grain may be re-magnetised into different states on each heating cycle.

In situ oxidation of magnetite grains

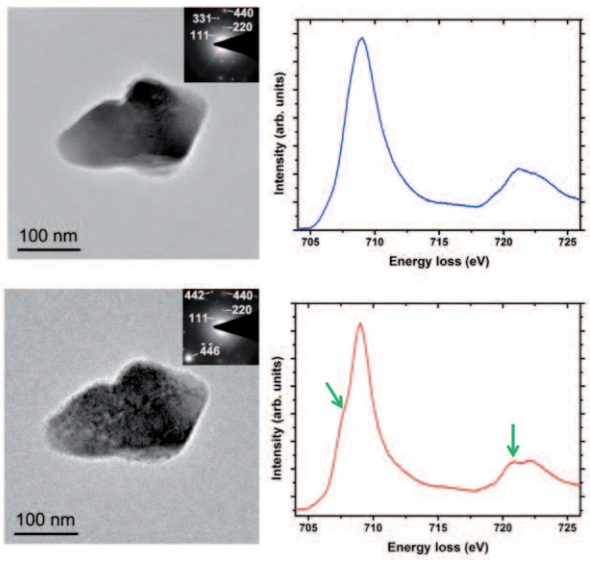

Fig. 3. Bright-field TEM images (left, with selected area electron diffraction patterns inset) and electron energy-loss spectra of the Fe L2,3 edge (right) recorded from a 250 x 150 nm magnetite grain before (top) and after (bottom) *in situ* heating to 700 °C in 9 mbar of O_2 for 8 hours in an environmental TEM. The green arrows highlight peaks in the electron energy-loss spectrum that are indicative of oxidation towards γ-Fe_2O_3. Adapted from Ref. 13.

In addition to the effect of temperature described in Fig. 2, the magnetic states of magnetite grains can be affected over time by progressive oxidation to less magnetic iron oxides, such as maghemite (γ-Fe_2O_3) or haematite (α-Fe_2O_3). In order to study such processes, which are especially poorly understood for grains that contain multi-domain magnetization states, magnetite particles were dispersed in distilled water using an ultrasonic bath, deposited onto a heating chip and studied using environmental transmission electron microscopy (ETEM) [12] in combination with electron energy-loss spectroscopy and off-axis electron holography. *In situ* oxidation of the particles was performed using a Protochips heating holder in an FEI Titan E-Cell TEM operated at 300 kV. Off-axis electron holograms were acquired at 300 kV in Lorentz mode using an FEI Titan 800-300 TEM, with an electron biprism operated at 160 V and an acquisition time of 4 s.

Samples were initially heated to 700 °C in the Titan 80-300 TEM for 1 hour and then cooled under vacuum, before acquisition of off-axis electron holograms from the native magnetite grains. The specimen holder was then transferred to the Titan E-Cell TEM for the purpose of *in situ* chemical oxidation, followed by imaging and electron energy-loss spectroscopy under vacuum at ambient temperature conditions. (*In situ* oxidation was always performed in the absence of the electron beam to avoid degradation of the specimen through electron beam/ specimen interactions during annealing). The specimen holder and oxidized magnetite grains were then transferred back to the Titan 80-300 TEM in order to acquire off-axis electron holograms. In order to separate the magnetic contribution to the phase shift from the recorded signal, the direction of magnetization in each particle was always reversed *in situ* in the TEM using the procedure described in the previous section.

Fig. 3 and 4 illustrate the effect of oxidation on an elongated (~250 nm x ~150 nm) synthetic magnetite grain as it was transformed towards γ-Fe_2O_3 [13]. The bright-field TEM image at the top left of Fig. 3 shows an initial smooth-surfaced grain, while electron energy-loss spectroscopy of the Fe *2p* $L_{2,3}$ edge confirms the presence of pure magnetite. In contrast, after exposure to 9 mbar of O2 at 700 °C for 8 hours in the ETEM, degradation of the surface of the grain is apparent and changes to the electron energy-loss spectrum are indicative of a change in the Fe oxidation state towards γ-Fe_2O_3 or α-Fe_2O_3.

Selected area electron diffraction did not reveal any evidence for the formation of additional crystalline phases during conversion of the inverse spinel ferrite Fe_3O_4 towards the crystallographically similar Fe^{2+} cation-deficient γ-Fe_2O_3 phase.

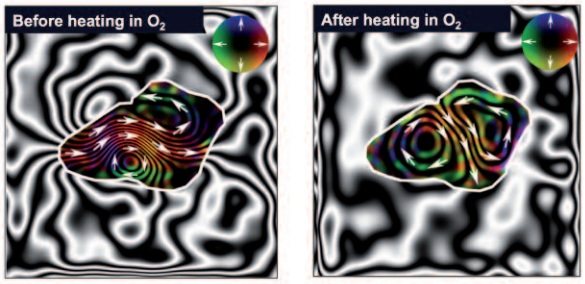

Fig. 4. Magnetic induction maps recorded using off-axis electron holography in magnetic-field-free conditions from the magnetite grain shown in Fig. 3 before (left) and after (right) *in situ* heating to 700 °C in 9 mbar of O_2 for 8 hours in an environmental TEM. The phase contour spacing is 0.20 radians. The direction of the measured magnetic induction is shown using arrows and colours, as depicted in the colour wheels. Adapted from Ref. 13.

Corresponding magnetic induction maps, which are shown in Fig. 4, show closely-spaced magnetic contours flowing from left to right through the elongated particle before oxidation, interacting with a small vortex located at the bottom, along with a component of stray magnetic field that is indicative of a pseudo-single-domain state. After oxidation, the magnetic induction map exhibits two vortices with widened magnetic phase contour spacings, flowing in opposite directions around a central transverse axis. The widening of the magnetic contours demonstrates that chemical alteration can lead to a loss of magnetization intensity. It is proposed that the tips of the elongated grain are more susceptible to oxidation because of their larger exposed surface area and shorter diffusion pathways, resulting in preferential oxidation towards the less magnetic γ-Fe_2O_3 phase around a lower aspect ratio Fe_3O_4 core. The results show directly the decrease in the natural remanent magnetization intensity of a palaeomagnetic sample as a consequence of oxidation.

In situ electrical biasing of an atom probe needle

Fig. 5 illustrates the recent application of off-axis electron holography to the measurement of the electrostatic potential and electric field around an electrically-biased metallic needle that was prepared for examination using atom probe tomography [14, 15]. Although the influence of the shape, crystallography and chemical composition of such a needle on ion trajectories can in principle be simulated numerically, the development of an experimental technique that can be used to measure the electric field directly, or equivalently the charge distribution within it, promises to provide a more direct method for minimising artefacts in atom probe tomography.

An Fe-0.3 wt% Y_2O_3 needle with a tip radius of below 100 nm was prepared for examination under an applied electrical bias *in situ* in the TEM using a scanning tunnelling microscopy specimen holder from Nanofactory Instruments. The needle, which is shown in Fig. 5a, was mounted on one side of the holder, while an electrochemically-sharpened W counter-electrode was moved towards it in an FEI Titan 80-300 TEM until the distance between them was approximately 1 µm. Off-axis electron holograms of the end of the needle were acquired operated at 300 kV using 8 s exposure times and an interference fringe spacing of 3.4 nm.

A model-independent approach based on integration of the Laplacian of the phase or, equivalently, contour integration of the gradient of the phase, was used to determine the charge density distribution along the needle directly from each phase image [16]. A key advantage of using this approach to measure the charge density, rather than determining the potential or the electric field directly, is that it is insensitive to the presence of a perturbed vacuum reference wave, so long as the region from which the reference wave is obtained is charge-free. It is also applicable to specimens of arbitrary geometry, requires only a basic knowledge of the likely positions of the charged objects within the field of view and is insensitive to the perturbed reference wave so long as it does not itself enclose any charge. The primary disadvantage is that, for a specimen whose thickness and/or composition changes across the field of view, the measured charge density can be affected by the mean inner potential contribution to the recorded phase shift, as a result of the presence of effective local dipoles on the specimen surface. Subtraction of the mean inner potential (and magnetic) contribution to the phase from the results was therefore found to be essential and was achieved by using the object wave recorded at 0 V bias as a reference wave for reconstructing electron holograms acquired at other applied voltages, before applying the model-independent approach to determine the charge density from the final subtracted phase images.

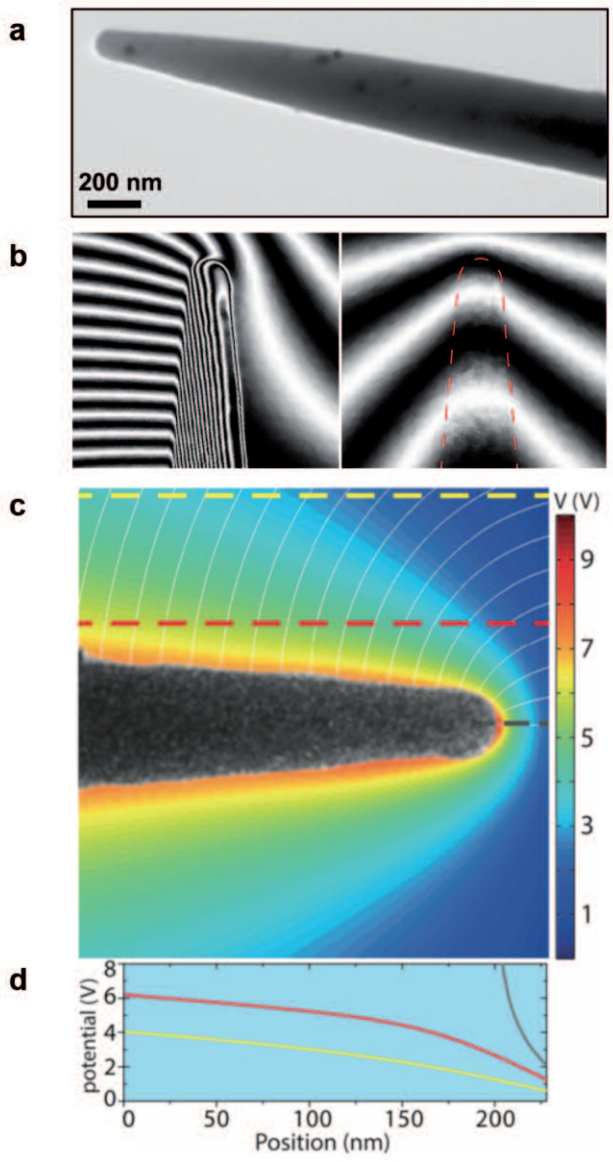

Fig. 5. (a) Bright-field TEM image showing an Fe atom probe tomography needle containing Y_2O_3 particles. A voltage was applied between the needle and a counter-electrode *in situ* in the TEM.
Fig. 5. (b) Experimental contoured phase image of the Fe needle recorded using off-axis electron hologrphy before (left) and after (right) removing the mean inner potential and magnetic contributions to the phase by taking the difference between phase images acquired at applied bias voltages between the needle and the counter-electrode of 0 and 5 V. The distance to the counter-electrode is approximately 1 μm. The phase amplification factor is 1.
Fig. 5. (c) Central slice of the three-dimensional electrostatic potential (colours) and electric field (white lines) between the Fe atom probe tomography needle and the counter-electrode, determined from the charge density distribution in the needle measured from the difference between phase images recorded using off-axis electron holography at applied bias voltages between the needle and the counter-electrode of 0 and 5 V. The amplitude image of the needle is overlaid.
Fig. 5. (d) Line profiles of the magnitude of the electrostatic potential along the dashed lines marked in (c). Reprinted with permission from Ref. 14. Copyright 2015, AIP Publishing LLC.

Fig. 5b shows, on the left, the cosine of an as-acquired phase image, in which the contributions to the phase from the mean inner potential, the applied bias and the magnetic field are all still present. As mentioned above, the mean inner potential and magnetic contributions to the phase were subtracted by taking the difference between phase images recorded at different applied bias voltages (*e*.g., 0 and 5 V). This procedure also resulted in subtraction of the contribution to the perturbed reference wave from the magnetic field of the needle. Contour integration was then applied to final subtracted phase images, such as the phase image whose cosine is shown on the right of Fig. 5b.

Fig. 5c shows a central slice taken through the three-dimensional electrostatic potential and electric field distributions that were inferred, on the assumption of cylindrical symmetry, from the measured charge density distribution along the needle, which showed charge accumulation at the apex of the needle, where the charge density was measured to be 2.45 *e*–/nm. As expected, the measured equipotential contours lie close to the surface of the needle. Fig. 5d shows profiles extracted from the three-dimensional electrostatic potential along the lines shown in Fig. 5c. These results provides a step towards the determination of three-dimensional charge densities, electric fields and electrostatic potentials of more realistic atom probe needles that contain both metallic and dielectric phases. Interestingly, complicated caustic phenomena could also be observed in defocused bright-field TEM images of similar needles *in situ* in the TEM [17].

Future prospects

The above examples illustrate a selection of recent experiments that involve the application of external stimuli, such as temperature, gas and applied voltage, to nanoscale specimens while acquiring off-axis electron holograms to record information about electromagnetic fields with sub-10-nm spatial resolution. In such studies, it is important to remember that the specimen must remain clean, electron-beam-induced charging due to secondary electron emission must be minimised and the quantitative interpretation of phase shifts measured from crystalline specimens can require comparisons with dynamical simulations, even for a specimen thickness of only a few atoms.

We are presently extending the present studies by developing model-based approaches that can be used to reconstruct three-dimensional magnetization or charge density distributions in specimens from series of phase images recorded using electron holography. Such approaches can be used to avoid many of the artefacts that result from the use of classical backprojection-based tomographic techniques, as well as allowing additional constraints and known physical laws to be taken into account.

Other recent developments in electron holography have included the development of advanced tomographic specimen holders [18], new approaches for recording three-dimensional electrostatic potentials and magnetic fields tomographically [19-21] and the development of split-illumination electron holography for acquiring a reference electron wave that is less perturbed by the field of the specimen itself [22]. Such developments suggest that off-axis electron holography has a very strong future as a technique for characterising electromagnetic fields in materials with the highest spatial resolution.

Acknowledgments

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References

1. D. Gabor, Microscopy by reconstructed wave-fronts, Proc. R. Soc. London A **197** (1949), 454-487.
2. G. Pozzi, M. Beleggia, T. Kasama and R. E. Dunin-Borkowski, Interferometric methods for mapping static electric and magnetic fields, Comptes Rendus Physique **15** (2014), 126-139.
3. R. E. Dunin-Borkowski, M. R. McCartney and D. J. Smith, Electron holography of nanostructured materials, Chapter in Volume 3 of the "Encyclopedia of Nanoscience and Nanotechnology", pp. 41-100, edited by H. S. Nalwa (American Scientific Publishers, 2004).
4. E. Snoeck, C. Gatel, L. M. Lacroix, T. Blon, S. Lachaize, J. Carrey, M. Respaud and B. Chaudret, Magnetic configurations of 30 nm iron nanocubes studied by electron holography, Nano letters **8** (2008), 4293-4298.
5. M. Varón, M. Beleggia, T. Kasama, R. J. Harrison, R. E. Dunin-Borkowski, V. F. Puntes and C. Frandsen, Direct observation of dipolar magnetism in low-dimensional nanoparticle assemblies, Scientific Reports 3 (2013), 1234.
6. S. Yazdi, T. Kasama, M. Beleggia, M. S. Yekta, D. W. McComb, A. C. Twitchett-Harrison and R. E. Dunin-Borkowski, Towards quantitative electrostatic potential mapping of working semiconductor devices using off-axis electron holography, Ultramicroscopy **152** (2015), 10-20.
7. A. Marchewka, D. Cooper, C. Lenser, S. Menzel, H. Du, R. Dittmann, R. E. Dunin-Borkowski and R. Waser, Determination of the electrostatic potential distribution in Pt/Fe:$SrTiO_3$/Nb:$SrTiO_3$ thin-film structures by electron holography, Scientific Reports **4** (2014), 6975
8. K. Yamamoto, Y. Iriyama, T. Asaka, T. Hirayama, H. Fujita, C. A. J. Fisher, K. Nonaka, Y. Sugita and Z. Ogumi, Dynamic visualization of the electric potential in an all solid state rechargeable lithium battery, Angewandte Chemie **122** (2010), 4516-4519.
9. J. F. Einsle, C. Gatel, A. Masseboeuf, R. Cours, M. A. Bashir, M. Gubbins, R. M. Bowman and E. Snoeck, *In situ* electron holography of the dynamic magnetic field emanating from a hard-disk drive writer, Nano Research **8** (2014), 1241-1249.
10. T. Suzuki, S. Aizawa, T. Tanigaki, K. Ota, T. Matsuda and A. Tonomura, Improvement of the accuracy of phase observation by modification of phase-shifting electron holography, Ultramicroscopy **118** (2012), 21-25.
11. T. P. Almeida, A. R. Muxworthy, A. Kovacs, W. Williams and R. E. Dunin-Borkowski, Visualisation of high temperature magnetisation states in magnetite grains using off-axis electron holography, J. Phys.: Conf. Series **644** (2015), 012027.
12. T. W. Hansen, J. B. Wagner and R. E. Dunin-Borkowski, Aberration corrected and monochromated environmental transmission electron microscopy: challenges and prospects for materials science, Materials Science and Technology **26** (2010), 1338-1344.
13. T. P. Almeida, T. Kasama, A. R. Muxworthy, W. Williams, L. Nagy, T. W. Hansen, P. D. Brown and R. E. Dunin-Borkowski, Visualised effect of oxidation on chemical remanent magnetisation of pseudo-single-domain magnetite particles, Nature Communications **5** (2014), 5154.
14. V. Migunov, A. London, M. Farle and R. E. Dunin-Borkowski, Model-independent measurement of the charge density in an Fe atom probe needle using off-axis electron holography without mean inner potential effects, J. Appl. Phys. **117** (2015), 134301.
15. M. Beleggia, T. Kasama, R. E. Dunin-Borkowski, D. J. Larson, T. F. Kelly and G. Pozzi, Towards quantitative electron holographic mapping of the electric field around the tip of a sharp biased metallic needle, J. Appl. Phys. **116** (2014), 024305.
16. M. Beleggia, T. Kasama, R.E. Dunin-Borkowski, S. Hofmann and G. Pozzi, Direct measurement of the charge distribution along a biased carbon nanotube bundle using electron holography, Appl. Phys. Lett. **98** (2011), 243101.
17. A. H. Tavabi, V. Migunov, C. Dwyer, R. E. Dunin-Borkowski and G. Pozzi, Tunable caustic phenomena in electron wavefields, Ultramicroscopy **157** (2015), 57-64.
18. R. Tsuneta, H. Kashima, T. Iwane, K. Harada and M. Koguchi, Dual-axis 360° rotation specimen holder for analysis of three-dimensional magnetic structures, Microscopy **63** (2014), 469-473.
19. T. Tanigaki, Y. Takahashi, T. Shimakura, T. Akashi, R. Tsuneta, A. Sugawara and D. Shindo, Three-dimensional observation of magnetic vortex cores in stacked ferromagnetic discs, Nano Letters **15** (2015), 1309-1314.
20. D. Wolf, A. Lubk, A. Lenk, S. Sturm and H Lichte, "omographic investigation of Fermi level pinning at focused ion beam milled semiconductor surfaces, Appl. Phys. Lett. **103** (2013), 264104.
21. P. Simon, D. Wolf, C. Wang, A. A. Levin, A. Lubk, S. Sturm, H. Lichte, G. Fecher and C. Felser, Synthesis and three-dimensional magnetic field mapping of Co_2FeGa Heusler nanowires at 5 nm resolution, Nano Letters (2015), doi: 10.1021/acs.nanolett.5b03102.
22. T. Tanigaki, Y. Inada, S. Aizawa, T. Suzuki, H. S. Park, T. Matsuda, A. Taniyama, D. Shindo and A. Tonomura, Split-illumination electron holography, Appl. Phys. Lett. **101** (2012), 043101.

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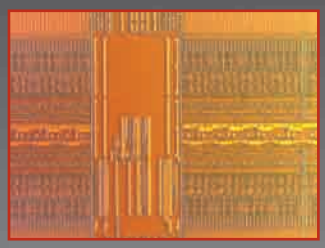

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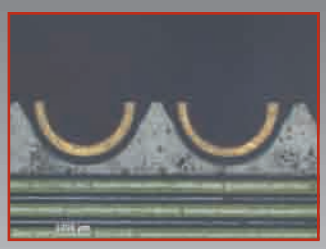

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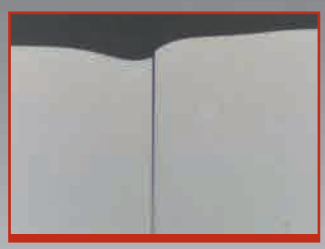

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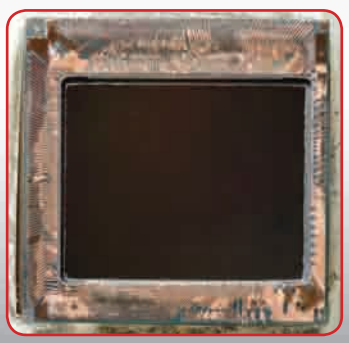
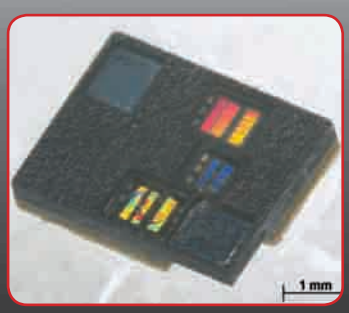
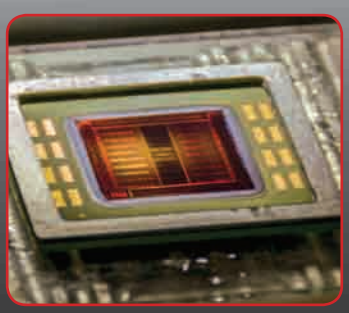


Targeted Stacked Die Exposure



Open areas as small as 100 x 100 µm



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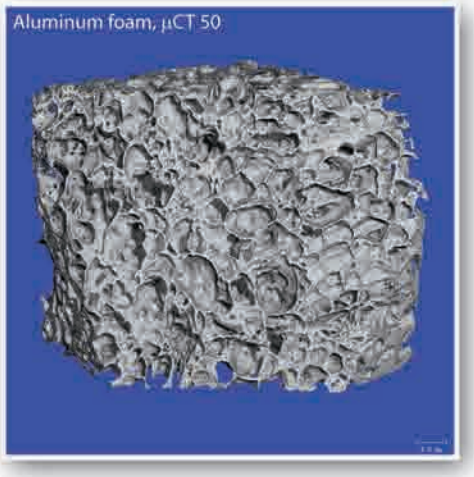

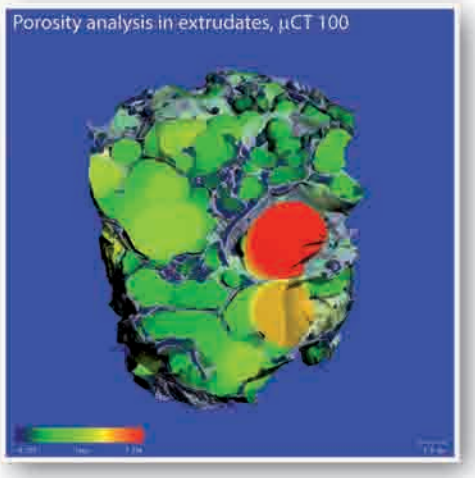

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REPORTS ON EMS SPONSORED EVENTS

EMS SPONSORED EVENTS IN 2015

- **Winterschool 2015, Practical course in advanced 3D microscopy**

  18 to 23 January 2015, Zurich – Switzerland

- **EM and CryoEM workshop @ Technion**

  22 to 25 February 2015, Haifa – Israel

- **19th International Conference on Microscopy of Semiconducting Materials (MSM-XIX)**

  29 March to 02 April 2015, Murray Edwards College, University of Cambridge – Cambridge – United Kingdom

- **2nd Uppsala Spectroscopy Workshop**

  18 to 20 May 2015, Ångström Laboratory – Uppsala – Sweden

- **Advanced Course on Cryo-Electron Tomography**

  08 to 12 June 2015, Vienna – Austria

- **Electron Crystallography School**

  28 to 31 August 2015, Duga Uvala – Croatia

- **Microscopy at the Frontiers of Science 2015**

  09 to 11 September 2015, Porto – Portugal

Notes :

MICROSCOPY OF SEMICONDUCTING MATERIALS, MURRAY EDWARDS COLLEGE, UNIVERSITY OF CAMBRIDGE, UK

Microscopy of Semiconducting Materials

The 19th international conference on 'Microscopy of Semiconducting Materials' was held at Murray Edwards College, University of Cambridge, 29 March - 2 April 2015. It was organised by the Institute of Physics and financially supported by the Royal Microscopical Society, the European Microscopy Society (EMS), the Materials Research Society of the USA and, as Platinum sponsor, HREM Research.

The conference series, held in odd years since 1979, deals with advances in semiconductor studies carried out by all forms of microscopy. As semiconductor devices continue to shrink further, new routes for device processing and characterisation need to be developed, and methods that offer sub-nanometre spatial resolution are highly valuable. The various methods of imaging, diffraction and spectroscopy available in modern transmission electron microscopy (TEM) are powerful tools for studying the lattice structure, electronic structure, chemistry and also electric fields in semiconducting materials. Advances from lens aberration correction in both TEM and scanning TEM (STEM) instruments to the development of a wide range of scanning probe techniques, as well as new methods of signal quantification have been presented.

This meeting was attended by 118 delegates from 22 countries, comprising 14 EU countries as well as Australia, Israel, Japan, Nigeria, Russia, Switzerland, Taiwan and the USA. A total of 117 scientific presentations were made, including 15 invited talks, 42 contributed talks and 60 poster presentations. The EMS sponsorship contributed towards organising the opening session on analytical STEM, with invited talks by Ondrej L Krivanek, Phil E Batson and Jannik C Meyer.

The following companies presented trade stands: Agar Scientific, Cameca, Fischione, Gatan, Hitachi, HREM Research, Linkam, LOT and Quorum Technologies.

Three students were awarded prizes for the high quality of their presentations: Duncan Johnstone (Cambridge), Natalia Stolyarchuk (Berlin) and Jürgen Münzner (Marburg). Their contributions covered a broad range of techniques and materials, documenting the excellent standard of microscopy achieved by young scientists.

The proceedings of the conference are published in two special issues: the Journal of Microscopy will present method and instrumentation based contributions (to appear in 2016) while Semiconductor Science and Technology already published the more materials or device oriented manuscripts in its November 2015 issue.

Thomas Walther

Conference photo taken at the college entrance, with about half of the attendees, just before a punt tour on the free Tuesday afternoon

2ND TEM SPECTROSCOPY WORKSHOP, UPPSALA UNIVERSITY, SWEDEN

Uppsala University hosted the 2nd TEM Spectroscopy workshop between May 18th – 20th 2015. The workshop brought together over 70 researchers from 15 different countries to report on the state of knowledge for the application of spectroscopy techniques such as Energy Dispersive X-Ray Spectroscopy (EDX) and Electron Energy Loss Spectroscopy (EELS) on the nanoscale. The participants included 8 invited speakers and representatives from the 6 industry sponsors: Bruker, FEI, Gatan, JEOL, Oxford Instruments, and Spectral Solutions.

The workshop began Monday, May 18th with two tutorial sessions on the most widely used TEM spectroscopy techniques, EELS and EDX, held by Helmut Kohl (University of Münster, Germany) and Nestor J. Zaluzec (Argonne National Laboratory, USA), respectively. Session II focused on 3D spectroscopic tomography and data treatment with an invited contribution from Jo Verbeeck (University of Antwerp, Belgium) entitled "Advances in model-based quantification of EELS spectra." Sessions III and IV focused on applications of EELS, with the first session focusing on low-loss and the second session focusing on ELNES. Michael Stöger-Pollach (Vienna University of Technology, Austria) held an invited contribution entitled "Probing optical properties using valence EELS" while Richard Brydson (SuperSTEM Daresbury, UK) presented an invited contribution "Nanostructural development in graphitizing and non-graphitising carbons probed using TEM/EELS." The day was concluded with open round-table discussions involving participants and the invited speakers.

Tuesday, May 19th began with session V, which covered applications of EDX spectroscopy and included an invited contribution from Shunsuke Muto (Nagoya University, Japan). Session VI focused on recent advancements in extracting nanoscale magnetic information from TEM samples and was kicked off with an invited presentation from Juan Carlos Idrobo (Oak Ridge National Laboratory, USA) entitled "Utilizing the phases in electron probes for chiral spectroscopy." Session VII showcased new instrumentation and applications and included talks from the industry sponsors. The final session, VIII, discussed spectroscopy at high spatial and energy resolutions and included an invited talk entitled "Advances in Aberration-corrected STEM and EELS" from Niklas Dellby (Nion Company, USA). Following the presentations, the workshop dinner was held at a nearby restaurant.

Wednesday, May 20th consisted of a laboratory exercises and included live TEM sessions demonstrating how to align and calibrate a TEM for EELS Spectroscopy, a tutorial for using the Digital Micrograph software package, live remote demonstrations of modern TEM equipment, and a tutorial on recent developments in EDX software.

Dr. Thomas Thersleff,
on behalf of the scientific organizing committee,
Dr. Thomas Thersleff, Prof. Klaus Leifer, and Dr. Jan Rusz

ADVANCED COURSE ON CRYO-ELECTRON TOMOGRAPHY VIENNA, AUSTRIA

Photo: Harald Kotisch, CSF-EM Facility

The Electron Microscopy Facility of the Campus Science Support Facilities (CSF) and Nexperion – Solutions for Electron Microscopy jointly organized an international advanced course on Cryo-Electron Tomography at the Vienna Biocenter in Austria. From June 6 to 12, 2015 a total of 20 participants from Austria, France, Germany, Italy, Sweden, Switzerland, The Netherlands, United Kingdom and the USA attended the course which was divided into two parts: a two-day long pre-course focused on the basics of Linux, electron tomography and IMOD to prepare less-experienced participants and a five-day long main course targeted at an advanced audience and covering all steps involved in cryo-electron tomography, from cryo sample preparation and tilt series acquisition via Serial-EM to tomogram reconstruction, visualization with IMOD and subtomogram averaging using PEET.

Several social activities during the evenings as well as a non-scheduled campus-wide power outage provided enough distraction from the demanding scientific program and allowed the participants to explore the city and to network.

In addition to sponsorship by Gatan, Leica Microsystems, Sciences Services and Quantifoil, travel cost contributions by the European Microscopy Society provided for the assembly of a team of seven instructors and guest lecturers including Drs. Johanna Höög (University of Gothenburg, Sweden), Mikhail Eltsov (Göthe University Frankfurt, Germany) and David Mastronarde (University of Colorado Boulder, United States). More than 40 lectures and hands-on training sessions delivered in-depth understanding to participants.

A similar course with a focus on STEM tomography is planned for June 2016 in Regensburg, Germany.

Thomas Heuser,
CSF-EM Facility (http://www.csf.ac.at/em)
Günter Resch,
Nexperion e.U. (http://www.nexperion.net)

ELECTRON CRYSTALLOGRAPHY SCHOOL – ECS2015, POREČ, CROATIA

Following the annual tradition of offering an electron crystallography school across Europe, this year's Electron Crystallography School – ECS2015 was organized from 28 till 31 August 2015 in Pore, Croatia. The speciality of the most recent school was that it was attached to a large crystallographic event - ECM29 as a satellite meeting. The neighbourhood of the crystallographic community gave a unique possibility to expose electron crystallography to the broad auditorium.

The peculiar topic of the school - standing on the crossroads between crystallography and electron microscopy - attracted students from the X-ray crystallography field willing to expand their methods collection to electron diffraction and electron microscopists eager to learn about non-standard use of electron images and diffraction.

The school's program comprised 3 days of lectures and tutorials as well as a poster session.

A set of 4 lectures was given during the morning session of each day addressing specific topics. During the first day, lectures covered the basic crystallography concepts and specifics of their applications to electron diffraction. The second day lectures gave insights into the electron diffraction tomography methods, the phase problem and crystallographic structure analysis methods for electron diffraction. The third day was devoted to specific crystallographic problems – lattice defects, modulated structures and poorly crystalline materials, seen by electron scattering.

Tutorials were offered during the afternoon sessions of each day also addressing dedicated topics. Two hours basic crystallography tutorials trained students in solving simple tasks related to symmetry determination, indexing of electron diffraction patterns, lattice transformation and calculation of the structure factors. All these tasks were solved with an aid of pen and paper and were particularly acknowledged by the students in the school evaluation forms. The students had a chance to work with different software packages for electron diffraction data processing and perform structure analysis of simple compounds applying different techniques such as direct methods and charge flipping.

Lectures and tutorials were designed in an integrated way building upon each other. For example, during the lectures, alternative approaches to the analysis of diffuse scattering were discussed followed by a tutorial on diffraction data simulation from disordered structures. Finally, a lecture and a tutorial on programming gave students a possibility to make first steps in the coding.

Basic crystallography tutorial: Left, Jose Fernandes (Como, Italy) and right, Artem Abakumov (Antwerp, Belgium)

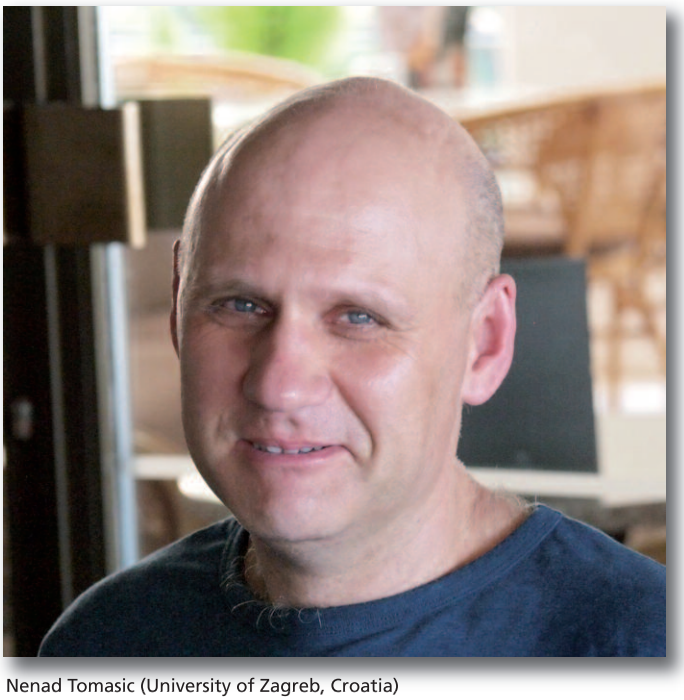
In addition to classroom discussions, the students were given the opportunity to present their research during the poster session and discuss their findings with the lecturers and other students. Generous sponsorship from the private sector in the form of poster prizes provided an additional incentive powerfully motivated the participants. Three poster prizes for the most excellent works were given to Olesia Karakulina (Antwerp, Belgium), Sung Jin Kang (Cambridge, UK) and Jose Fernandes (Como, Italy).
30 students participated in the school, coming from different countries – Poland, Germany, UK, Sweden, Spain, Turkey, Ireland, Czech Republic, Italy, Argentina, Croatia, Belgium and Switzerland. The active contribution and motivation of the students has to be particularly mentioned as a key asset of the school: all lectures were followed by deep sensible questions; the tutorials had a format of a vivid scientific dialog.

The financial support from IUCr was used to support the students: five IUCr young scientists' awards have been given.

We are grateful for the sponsorship of European Microscopy Society (EMS) in the form of traveling grants for lectures. This sponsorship was used to cover the traveling and accommodation expenses of Dr. Enrico Mugnaioli (University of Siena, Italy) and Dr. Maciej Zubko (University of Silesia, Poland) bringing their scientific expertise and teaching efforts to the school.

Finally the support from the parent meeting – the ECM29, and especially the continuous help of Dr. Nenad Tomasic (University of Zagreb, Croatia) in preparing the school as well as administrative support during the event is greatly acknowledged.

Tatiana E. Gorelik



Nenad Tomasic (University of Zagreb, Croatia)

EM AND CRYOEM@TECHNION, HAIFA, ISRAEL

Celebrating Electron Microscopy… In late February 2015 we held at the Technion – Israel Institute of Technology the largest international school ever held in Israel on EM and CryoEM methods for young scientists. More that 120 graduate students, postdocs and young researchers from all the Israeli universities and 11 European countries have participated. The comprehensive program included lectures by leading EM researchers and teachers in Israel, visits to the FIB/EM/CryoEM centers, personal meetings with the teachers and instructors, demonstrations of specimen preparation, short lectures by the participants, lively discussions, good food, and social activities in the host city of Haifa and the north of Israel.

As this was an educational activity, there was no registration fee. This was made possible by the generous contribution of multiple organizations – The Technion, the Israel Society for Microscopy (ISM), the European Microscopy Society (EMS), COST Action 1101 of the EU, The European Colloids and Interface Society (ECIS), the City of Haifa, the Russell Berrie Nanotechnology Institute (RBNI), and FEI Israel. We especially acknowledge the voluntary team of teachers and instructors from the Technion, The Weizmann Institute and the Ben-Gurion University for sharing with the young scientists their knowledge and passion on EM methods.

The participants specified that the team of teachers and the lecture topics were the main reasons that attracted them to register to the school. They were very pleased with the combination of lectures, visits to the centers, and the opportunity to openly discuss their projects with the experts. "**I felt very motivated and inspired by speakers, and learned a vast amount of new approaches that I plan to use in my PhD**" wrote a student from the UK in the feedback form – can we ask for more?

Prof. Dganit Danino
Organizer

MFS 2015 - MICROSCOPY AT THE FRONTIERS OF SCIENCE 2015, PORTO, PORTUGAL

mfs2015 - Microscopy at the Frontiers of Science 2015, the 4th Joint Congress of the Portuguese and Spanish Microscopy Societies, was held at the Faculdade de Engenharia da Universidade do Porto (FEUP) from 9 to 11 September 2015. The congress was attended by almost 150 participants, teachers, researchers and students from various universities, laboratories and research centres, mainly Spanish and Portuguese, but also by employees from companies that develop microscopy and microanalysis equipment.

The Congress was organized in three plenary morning sessions, followed by two parallel sessions, in the areas of life science and materials science, including nine invited lectures. A joint special session was also organized for the presentation of recent developments in techniques and instrumentation, by sponsors of the event. Two poster sessions took place on the 1st and 2nd day of the Congress. The total number of communications was one hundred and ten.

Three excellent plenary lectures brought an added value to the congress. Prof. Sir Colin Humphreys, presented the opening plenary lecture, untitled "How Microscopy at the Frontiers of Science can help to solve some major world problems"; "New Insights Into Nanomagnetism By Spin-Polarized Scanning Tunneling Microscopy" was the plenary lecture presented by Prof. Dr. Jürgen Kirschener; "Doing structural biology *in situ* – From cells to molecules" was the closing plenary lecture presented by Prof. Dr. Jürgen Plitzko.

Among the social events we should highlight the tour to the old town and to the Port wine cellars, including a welcome cocktail, and the Congress dinner. The awards for the best poster and for the best image contests, organized in parallel with the Congress, where delivered during dinner.

The Congress was supported by institutional and corporate sponsors, whose contribution was fundamental to the success of this event. Among the firsts, the support of the University of Porto, FEUP and the European Microscopy Society (EMS) was fundamental for the recognition of the scientific merit of this event. The EMS contributed to the travel expenses of two of the invited speakers of the Congress, Professors Colin Humphreys and Jürgen Plitzko.

Prof. Filomena Viana
Dep. de Engenharia Metalúrgica e de Materiais

EARLY MICROSCOPES. 17TH CENTURY

The historiography of the microscope is still under the spell of the successive editions - each time enriched and enlarged - of Pieter Harting's epochal Das Mikroskop (1848-1866), duly reprinted in 1970. Savile Bradbury, then, produced an interesting update (1967). More recent historiography only assessed headlines. Here I would like to highlight the first stage in the development of the microscope. It culminated in Leeuwenhoek's single lens.

What's in a word ?

The term 'microscopium' dates from April 1625 (Faber). It was just one of two kinds of 'perspicilla', instruments composed of one or more lenses to improve sight. It was also known as 'engyscopium' (Borel, 1656).

1. Introduction; Kepler and Galileo

The magnifying effect of glasses of a particular shape was already known in Antiquity. About 1270 special glasses were ground in Venice for bookish people, mostly elderly clergymen. Understandably, it became a pan-European business. Lenses - from lenticu-lae, lentils, the well-known leguminous vegetable - were initially exclusively plano-spherical or doubly spherical. Combinations of glasses must have been considered, if only to check the smoothness of the surface of a particular lens. Speculations on the potentialities of 'convex' and 'concave' lenses and their combinations abound in the literature of the late 16th century. All the same the magnifying effect on objects in the distance and its practical interest e.g. in warfare was publicly demonstrated not until 1608 by several people in the revolting Dutch Republic. The central idea was a plano-concave glass combined with a plano-convex one. When the instrument was used the other way around, the same objects that were magnified a moment ago, now looked smaller. A similar combination, used in the original way, also magnified tiny objects on the observer's desk, but, initially, this just seemed more of the same, given the familiarity with eyeglasses. Galileo, then, explored the heavens with his 'perspicillum'; his finds shocked the intelligentsia all over the Continent. Lesser known are his successful advances, later, in the visualization of the very small. Kepler, at Prague, had outlined in the mean time the geometrical details of the new field of research, focussing on the telescope. Long before, in 1604, he had coined already the fundamental notion of 'light pencil', which was key to explaining katoptrics and the imaging by the 'camera obscura' and the human eye. In the Dioptrice (1611), then, he characterized the main feature of light, its propagation, by the Latin verb 'vergere', hence the notions 'convergent' and 'divergent'. The science of 'scopes' was called after the 'diopter', a sighting tube used by astronomers to direct their instruments.

2. Drebbel and Descartes

A first type of magnifying instrument that made a lasting impression was conceived of about 1619 by Cornelis Drebbel who worked at Court in London. Two drawings of Drebbel's model survive and are reproduced in Fig.1. They concur in featuring a two-lens system on a tripod, together with an object table. The height is reported to be of a step's length (ca. 40 cm), its diameter that of a poulse (ca. 5 cm).

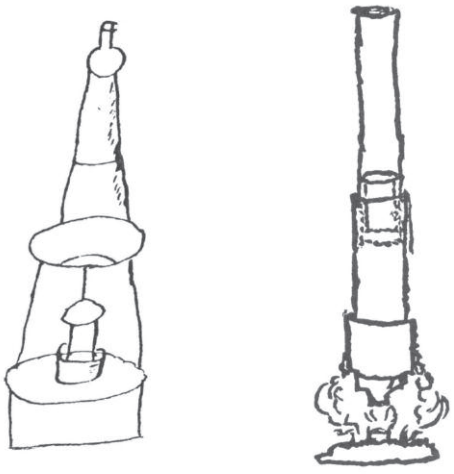


Fig.1 Isaac Beeckman's (left; 1631) and Christiaan Huygens' (right; 1654) impressions of microscopes made by Drebbel (ca. 1620).

The magnification was such that a (cheese) mite was seen as big as a big fly, that is, about 20-30×. Both models shown in Fig.1 suggest the presence of an objective (plus diaphragm) and an ocular about halfway the tube.

René Descartes followed in the footsteps of Kepler and analyzed the optimal forms of lenses (and mirrors). He proposed several new models of which one is depicted in Fig.2. The lens itself is plano-convex with a hyperbolic surface and embedded in an opaque mounting painted black or covered with

black velvet or velveteen on the out-side; on top, it is provided with a concave mirror or white-painted surface. Thanks to the velvet(een) the instrument may be pushed against the eye's socket, the exit pupil corresponding more or less to the eye's pupil. The object, then, is fastened on top of the crooked pin G at D in the focal point of the conjugated hyperbola and the whole directed at the sun. Descartes also devised—more jokingly, it seems—a huge microscope on a footing, a real gimmick of about 165 cm length, meant for both opaque and transparent objects.

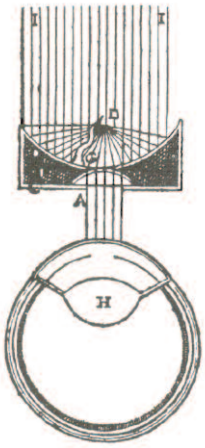


Fig.2 Descartes' idea of a single-lens microscope (plus the pupil of the observer) provided with a mirror to improve the illumination.

3. Robert Hooke

Robert Hooke had been the right hand of Robert Boyle before being nominated as 'curator of experiments' of the newly established Royal Society of London for Improving Natural Knowledge. Well aware of what was going on among the microscopists the Society charged Hooke with the construction of such an instrument. The highly gifted Hooke succeed and was, subsequently, invited to do weekly demonstrations to amuse the gathered members. Hooke opted for a Drebbel-type construction and provided it with an illumination system of his own device (Fig.3). Indirect sunlight could be focused on the 'object-table' with the help of globe full of brine and a plano-convex lens in a (wooden ?) diaphragm. In the evening an oil lamp functioned as the light source. The tube consists of four drawers mounted with an eyecup. The ocular is mounted in the outermost drawer.

Fig.3 Robert Hooke's preferred microscope with illumination system (1665).

But Hooke did more than just observing and admiring nature. He produced a wonderful atlas of engravings, Micrographia (1665), a treasure stove full of fascinating observations that brought about, once for all, the emancipation of the new field of research. A copy of this book must have been in the hands of a Dutch draper from Delft, in the Netherlands, one Antoni Leeuwenhoek. Leeuwenhoek elaborated on an idea of Hooke, namely, to use tiny beats of glass, a variant of Descartes' single-lens system, that is, without the mirror. It was a matter of melting the end-point of a glass thread and letting the glass drop solidify. The glass drop could subsequently be removed, ground and polished such as to become a tiny plano-convex lens. To make that lens readily manipulable it was mounted between two perforated metal plates (brass, silver, ..), the whole being provided with an 'object-table' in the form of an adjustible pin (Fig.4).

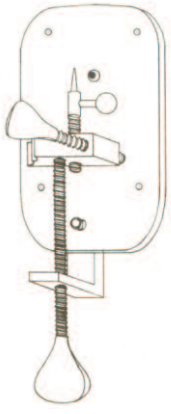


Fig.4 Construction of a Leeuwenhoek microscope.

In practice, Leeuwenhoek had two techniques to produce his lenses; most of the surviving microscopes appeared to be of the bead type, but one deviated significantly. The latter one was far stronger than the others, featured airbubbles, its geometry being non-spherical. This lens appeared to be superior to the 'bead'-lenses. A systematic investigation of the surviving lenses, conducted by Jaap van Zuylen in the 1970's, revealed that that unique lens was the result of a blowing technique, which, characteristically, produced powerful, though non-spherical lenses with here and there air inclusions. Van Zuylen even succeeded in producing such lenses himself (Fig.5). Interestingly, a copy of a microscope with a similar lens in a silver setting, resurfaced early 2015 in the United Kingdom (Fig.6). Its magnifying power appears to be in the order of 250, that is, close to that of the known one.

Fig.5 A replica of the strongest Leeuwenhoek lens blown, ca. 1980, by Jaap van Zuylen from a soft glass tube (on top; to be cut out).

Fig.6 The newly recovered Leeuwenhoek microscope with a blown lens in a silver setting (collection: Bert Degenaar).

Henk Kubbinga
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P.S. The author is currently editing "The collected papers of Frits Zernike (1888-1966)". Volumes I and II with the original papers appeared in 2012 (Groningen University Press); volumes III and IV, with English translations, followed early in 2016. Volume V, with 'Introductions', 'Bibliographies', etc., together with an 'Inventory of instruments used by Zernike' is bound to appear somewhat later. The collected papers [..] are EU-distributed by the present author.

NEW VERSION OF THE EELS AND XAS DATABASE

https://eelsdb.eu

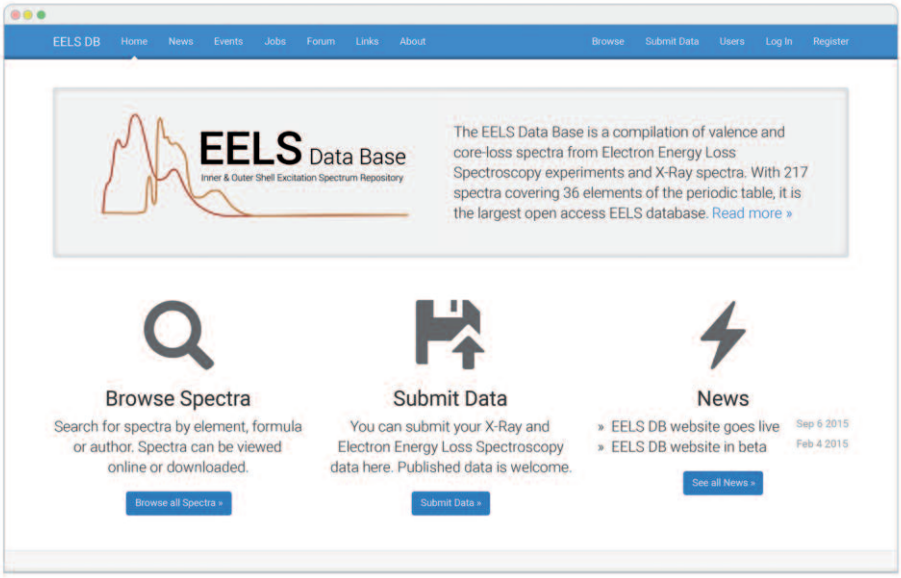
With more than 200 spectra covering 35 elements of the periodic table, the Electron Energy-Loss Spectroscopy (EELS) and X-ray Absorption Spectroscopy (XAS) database is the largest open-data electronic repository of spectra from EELS and XAS experiments. It was created in the late 1990s and a complete overhaul of the website was deemed necessary.

The database website has been completely rewritten, with an improved design, user interface and a number of new tools. **The database is freely accessible at https://eelsdb.eu/ and can now be used without registration**. The submission process has been streamlined to encourage spectrum submissions and the new design gives **greater emphasis on contributors' original work** by highlighting their papers.

With numerous new filters and a powerful search function, it is now simple to explore the database of several hundred of EELS and XAS spectra. Interactive plots allow spectra to be overlaid, facilitating online comparison. An application-programming interface has been created, allowing external tools and software to easily access the information held within the database. In addition to the database itself, users can post and manage job adverts and read the latest news and events regarding the EELS and XAS communities. **We encourage everyone to submit their spectra to the website.**

Dr. Luc Lajaunie
(University of Zaragoza, Spain)

ACKNOWLEDGEMENTS The following entities are acknowledged for the funding: *the Institut des Matériaux Jean Rouxel* (IMN, Nantes, France) and the *Centre d'Elaboration de Matériaux et d'Etudes Structurales* (CEMES, Toulouse, France) laboratories, the European microscopy network ESTEEM 2, the French microscopy network METSA and the French microscopy society Sfμ. We warmly acknowledge everyone who has contributed to the database and the beta-testers who greatly helped us to improve the website.



Homepage of the EELS and XAS database: ***https://eelsdb.eu***

Notes :

REPORTS ON SPECIAL EVENTS

Notes :

IAMNANO 2015 - JULY 7 - 10, 2015, HOTEL EMPIRE RIVERSIDE, HAMBURG, GERMANY

International Workshop on advanced and in-situ microscopies of functional nanomaterials and devices

An International Workshop on *Advanced and In-situ Microscopies of Functional Nanomaterials and Devices* / www.iamnano2015.com / was held from July 7 – 10, 2015 at the Hotel Empire Riverside in Hamburg, Germany. The workshop was organized by the Institute of Materials Research of the Helmholtz Zentrum Geesthacht - Centre for Materials and Coastal Research, in collaboration with an international advisory board.

The workshop provided a forum for researchers interested in the application of advanced and in-situ methods of electron microscopy and spectroscopy to materials research and for the nano-scale analysis of materials in current areas of technology. The application to the development of new materials in different technology fields was covered, such as electronics, optics, magnetics, energy and the environment, engineering materials, nanosystems, soft matter and bioscience. This workshop was the third of its kind, with about 110 participants from 23 countries in Europe, the Americas (Brazil, Canada, US) and Asia (Israel, Saudi Arabia, Singapore, Turkey, Japan) who presented their research in 42 oral and in 43 poster contributions.

In 8 methodological sessions, internationally renowned invited speakers addressed current developments provided by the aberration corrected electron microscopy and spectroscopy, and described the potential of the new methodological possibilities focusing on the following topics:

- Imaging with advanced methods of conventional and aberration-corrected electron microscopy: high-resolution TEM and scanning TEM (STEM)
- In-situ transmission electron microscopy techniques
- Image simulation and processing methods
- Electron holography and tomography
- Spectroscopic methods in TEM and SEM: EDXS, EELS, simulation tools
- Electron diffraction and electron backscatter diffraction (EBSD) techniques

The invited speakers of the following 6 sessions focused on applications of electron microscopy methods to materials science problems. Examples covered alloys, structural and functional materials for power generation, nanomaterials, and soft matter.

The oral sessions were complemented by a large poster session on the evening of the first conference day. Part of the broad spectrum of topical areas presented at this workshop is reflected by the titles of the invited contributions that can be found in the program of the workshop (for details see www.iamnano2015.com).

All participants of this workshop were enthusiastic about the scientific program and explicitly gave their positive feedback on the excellent quality of the presentations of the invited speakers as well as on the choice of the topical subject areas and the smooth overall organization. The concept to combine invited talks of internationally respected scientists with a large poster session attracting mainly junior scientists was successful and discussions between leaders in the field and newcomers were initiated on a broad range. Just one example of remarks by participants reads: (Citation) "Thanks again for organizing a really excellent meeting… IAMNano was one of the best meetings we've been to in a while, with consistently excellent talks and an outstanding cast of participants…".

In addition to the scientific program many opportunities for small talk and networking were given at a number of social events, like the get together on the first evening, the poster session and a conference dinner. All these occasions were used for lively discussions and were very positively received. Finally the beautiful location in the city of Hamburg contributed to the success and positive reception of the conference.

EPITAXY COMPETENCE CENTER AT THE TU BRAUNSCHWEIG, UNIVERSITY OF TECHNOLOGY

By inaugurating the epitaxy competence center ec² the cooperation within numerous publicly funded projects between the OSRAM Opto Semiconductors GmbH and the Institute of Semiconductor Technology at TU Braunschweig, University of Technology has been raised onto a new level of collaboration. The ec² envisions itself as a link between university research and industry, focusing on the optimization of the preparation and characterization of high-performance semiconductor materials based on gallium nitride for applications in light-emitting diodes, lasers or power electronics.

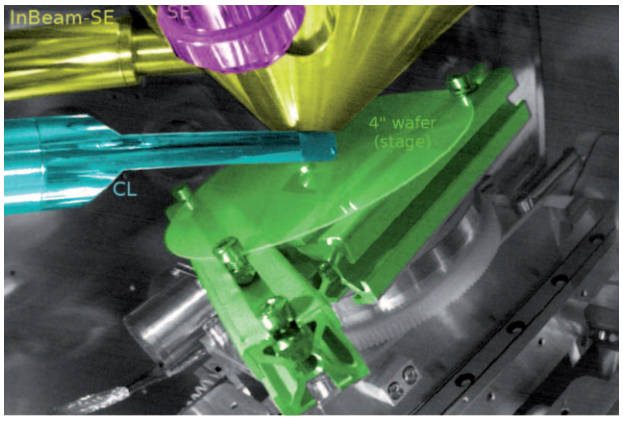
The team of the ec² was very pleased being able to welcome a quite large delegation from OSRAM Opto Semiconductors GmbH including CEO Aldo Kamper at the opening ceremony on 12th March 2015. Moreover, many representatives of important institutions not only from around Braunschweig attended the event, e.g. University of Magdeburg, Volkswagen AG, Fraunhofer Institute for Surface Engineering and Thin Films, PhotonicNet, Physikalisch Technische Bundesanstalt (PTB), Paul-Drude Institute, Berlin etc.

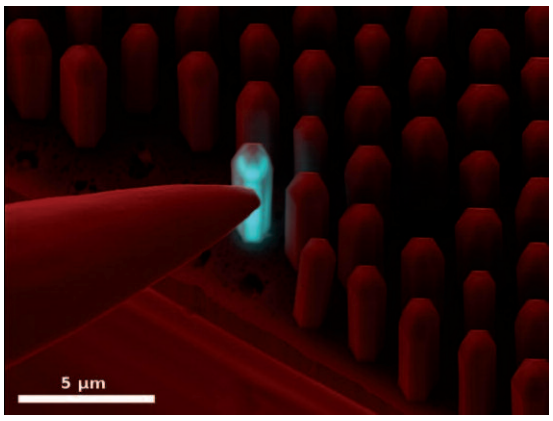
New FE-SEM for electro-optical characterization

Besides equipment for epitaxy and processing also a new FE-SEM with a cathodoluminescence detection system was installed at the ec² in February 2015 and already demonstrated during the opening ceremony. The Tescan Mira3 GMH FE-SEM equipped with a large chamber also includes active vibration isolation, a low-kV BSE and EBIC detection. The attached Gatan MonoCL4 contains a special parabolic collection mirror designed on request for investigation of full wafers up to 4" at tilt angles up to 30°. Kleindiek MM3A manipulators and triax cabling enable a precise electrical contacting of Nanostructures by up to three probe tips inside the focal point of the optical collection mirror. By this a simultaneous characterization of CL and EBIC as well as spectrally resolved electroluminescence can be observed already at driving currents of a few picoampere.

Overall, this SEM system enables a non-destructive electro-optical characterization of whole wafers in a tilted view. Thanks to the in-situ contacting also electrical measurements are possible without further preparation of contacts, e.g. on 3D-LEDs with a core-shell geometry and on axial nano-LEDs.

Johannes Ledig





Left: colorized photo highlighting the sample stage with a 4" wafer (green), modified parabolic mirror for light collection (cyan), pole piece with in-Beam SE (yellow) and SE detector (magenta).
Right: Color overlay of the SE (red) and EBIC (cyan) image of an ensemble of core- shell LEDs visualizing the light emitting region of a single 3D-LED contacted by a probe tip.

FWO EXCELLENCE PRIZE FOR GUSTAAF (STAF) VAN TENDELOO, ANTWERP, BELGIUM

On November 30th 2015, Prof. Gustaaf Van Tendeloo (University of Antwerp, Belgium) was awarded the prestigious FWO Excellence Prize. The prize was presented by the King of Belgium (far left in the image) during an official ceremony at the Bozar Centre for Fine Arts in Brussels.

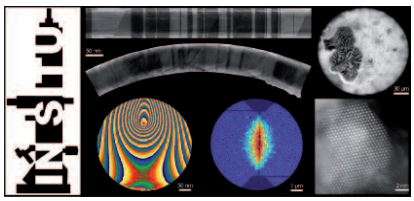
The FWO Excellence Prizes are awarded every five years in recognition of the scientific career of the most eminent Flemish researchers and are often referred to as the Flemish Nobel Prizes. Gustaaf Van Tendeloo was considered as an exceptional candidate for this Excellence Award.

During his career, he brought about several revolutions in the field of electron microscopy and his work has resulted in an extraordinary number of publications and citations. Under his directorship, the EMAT laboratory at the University of Antwerp became one of the leading microscopy groups in the world, by combining an impressive collection of state-of-the-art microscopes with the necessary expertise to perform and interpret advanced electron microscopy experiments.

The research of Gustaaf Van Tendeloo does not only have an important impact in microscopy, but also in materials science. Several of his articles were published in Nature or Science and can be regarded as breakthroughs in various fields such as superconductors, nanoparticles, Li-battery materials and assemblies of quantum dots. Professor Van Tendeloo is known as a very enthusiastic and driven scientist and has been a fabulous mentor to the more than 40 students who completed a PhD under his supervision. This Award should not only be seen as recognition of his past career, but as an additional encouragement to the future research at EMAT.

EMAT PhD and postdocs dancing to "We will survive" at the retirement party of Staf Van Tendeloo

AN ESTEEM2 WORKSHOP ON ADVANCED *IN SITU* TEM/STEM IN GOTHENBURG



Current Trends and Future Needs of Advanced Electron Microscopy for materials and nano science and technology were discussed at Chalmers University of Technology, Gothenburg, Sweden, on July 20th to 23rd, 2015

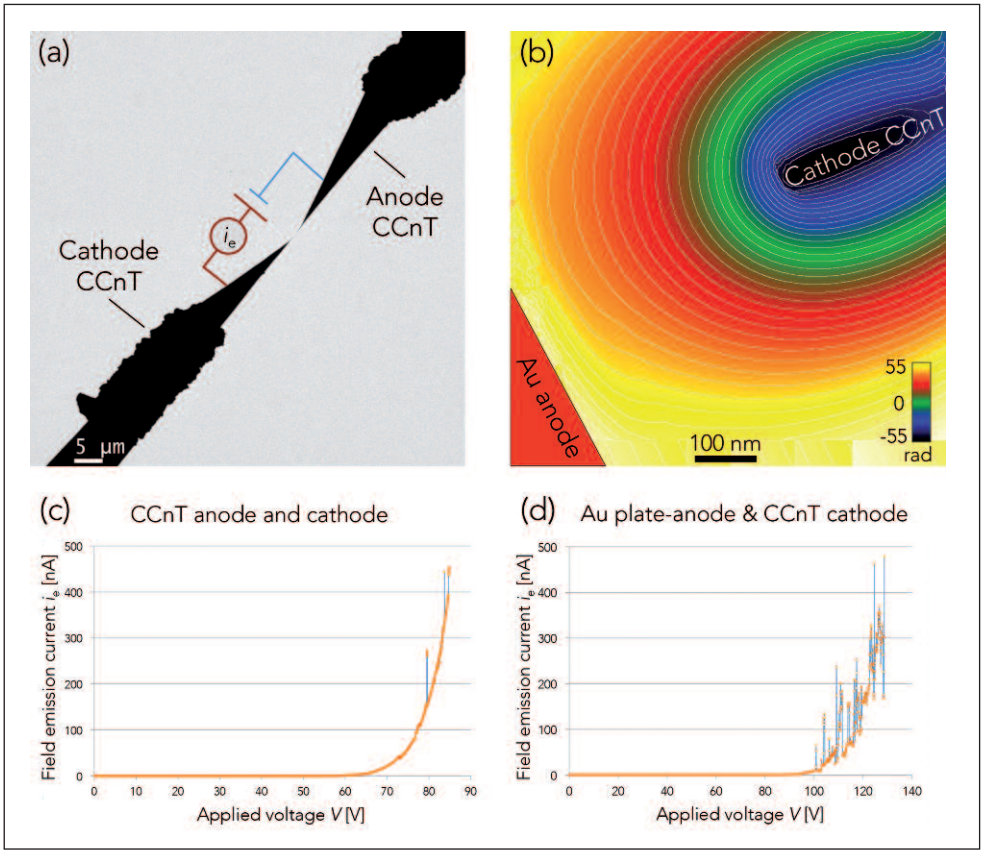
A workshop on Advanced *In Situ* TEM/STEM was held from July 20th to July 23rd, 2015, at Chalmers University of Technology in Gothenburg Sweden in the framework of ESTEEM2 (Enabling Science and Technology through European Electron Microscopy 2). The goal was to discuss the current trends and future needs of advanced electron microscopy for materials and nano science and technology. Recent advances in electron optics, microscope design, and sample environment control have enabled new quantitative investigations, analyses and measurements of materials that have broadened our understanding of the correlation between materials structure and the properties and function of technologically relevant devices. Advanced electron microscopy imaging and spectroscopy techniques allow us to probe important materials information that is unattainable using other techniques. The rapid growth of the advanced electron microscopy field, and its increasing ability to help solve technologically relevant material problems, highlights the need for continued support and development of the field. The vibrant group of scientists that gathered from around the world discussed the current capabilities of TEM/STEM instruments, the materials problems that TEM/STEM can help solve, the limitations of current TEM/STEM instruments, and the future needs that will keep the TEM/STEM community progressing.

The Workshop was chaired by Professor Eva Olsson (Chalmers University, Sweden) supported by the international scientific advisory board consisting of Wolfgang Jaeger (Christian-Albrechts-University Kiel, Germany) and Robert Sinclair (Stanford University, U.S.A). The program, practical sessions and social events were realized by the local organizing committee consisting of Eva Olsson, Olof Bäcke, Stefan Gustafsson, Ludvig de Knoop, Hanna Nilsson, Florian Nitze, Torben Pingel, Michael Schiffmann, Norvik Voskanian, Andrew Yankovich, and Lunjie Zeng.

More than 90 participants attended and contributed with their research to the Workshop coming from 14 countries, including Sweden, Germany, The U.S.A., Japan, France, Serbia, The Netherlands, Austria, The U.K., Slovenia, Poland, Denmark, Finland, and Canada. The academic and corporate sponsor of the workshop were FEI, Fischione instruments, HITACHI, CEOS, Vetenskapsrådet, Protochips, The Chalmers Nanoscience and Nanotechnology Area of Advance, DENSsolutions, STINT (The Swedish Foundation for International Cooperation in Research and Higher Education), JSPS (Japanese Society for the Promotion of Science), Spectral Solutions, Kungl. Vetenskapsakademien (The Royal Swedish Academy of Sciences), BRUKER, Oxford Instruments, JEOL, The Chalmers Materials Science Area of Advance, and GATAN.

The event provided a scientific program with presentations given by invited speakers and poster presenters to share their most recent research, as well as with practical sessions that allowed companies to share information about their products and techniques. The scientific sessions included the topics: 1) Advances in *In Situ* TEM/STEM, 2) Electron holography, 3) Advances in *In Situ* spectroscopy, 4) *In Situ* gaseous studies, 5) *In Situ* deformation studies, 6) Novel microscopy tools and techniques, and 7) *In Situ* thermal studies. These contributions demonstrated the importance of aberration correction on electron microscopy for materials research and provided information about recent advances of TEM/STEM techniques that help us gain information about electronic, optical, magnetic, energy, nano, soft, and bio materials. The practical sessions included presentations and demonstrations from FEI, Bruker, Protochips, JEOL, DENSsolutions, and Spectral Solutions about the details and capabilities of their products. In addition, invited speakers were asked to discuss their personal opinions on the future needs in advanced electron microscopy, and the workshop concluded with a discussion of topical problems and issues. In addition to the scientific and practical sessions, the workshop also contained a number of inspiring social events. Thank you to all the participants, invited speakers, and exhibitors for making this a memorable and successful event.

Eva Olsson,
Chalmers University, Sweden



(a) Bright field TEM micrograph of two carbon cone nanotips (CCnT) positioned opposite each other using the nanomanipulator of an in situ TEM biasing holder. The holder was used to increase the field on the tips until cold-field emission (CFE) was started (several volts per nm). (b) Unwrapped electron phase map extracted from an electron hologram obtained using the TEM biprism. The voltage on the Au plate-anode was varied from 0 to 130 V, enabling electrons to be emitted (starting at around 100 V) from the cathode (see i(V)-curve in (d)). (c) shows the field emission current i(V)-curve when CCnTs have been used as both cathode and anode (as in (a)). (d) is a similar curve obtained when a Au plate instead of a CCnT was used as anode, which increased the current noise up to 10 times. This is believed to come from increased ion bombardment on the cathode tip since the surface area on the anode is larger in (b) compared to in (a), which desorbs more molecules on the anode. de Knoop et al. Appl. Phys. Lett. 106 (2015).

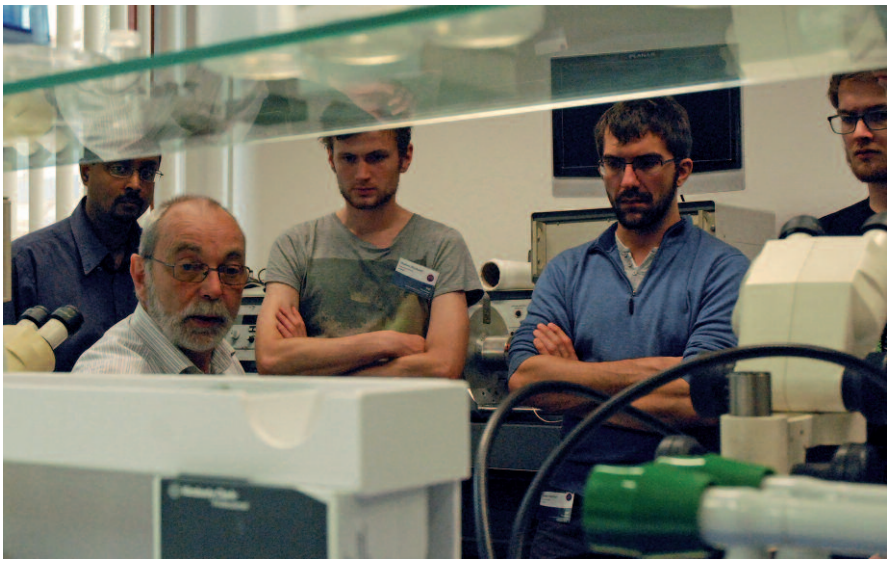
TEM WORKSHOP, EMAT, ANTWERP, BELGIUM

From June 8 - June 19 2015, the biannual workshop on Transmission Electron Microscopy was organised by EMAT (University of Antwerp).

The workshop provided a complete and hands-on training starting from the basic principles and covering a broad range of topics such as advanced high resolution transmission electron microscopy, analytical techniques in the transmission electron microscope and transmission electron microscopy for beam sensitive materials. There were more than 40 students attending the school, originating from 14 different countries.

All lectures were very much appreciated and also the practical sessions, both at the microscopes and in the computer labs were found to be very useful.

Sara Bals
EMAT laboratory



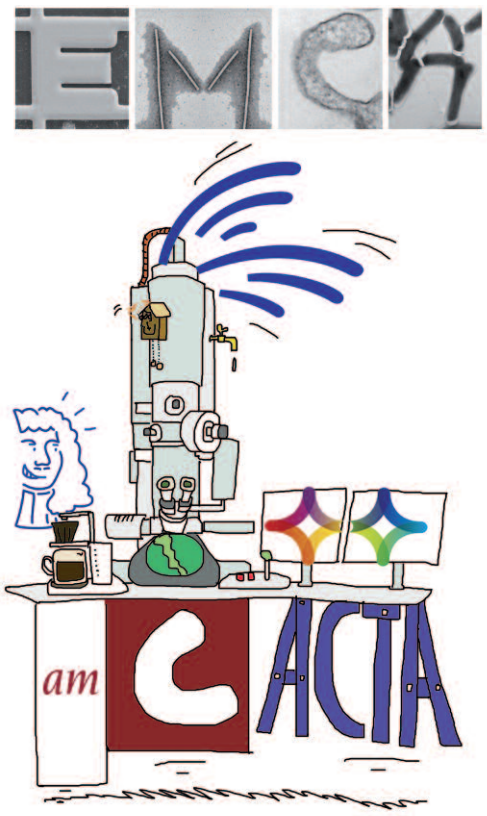
AMSTERDAM ELECTRON MICROSCOPISTS JOIN FORCES AND MICROSCOPES

On 28th of October, the opening of the Electron Microscopy Center Amsterdam (EMCA) was celebrated with a symposium with the title Imaging at high resolution, how to apply electron microscopy in research and diagnostics. The Amsterdam initiative to join electron microscopy is unique and involves all Amsterdam life science research institutes, including the Vumc, AMC, NKI, ACTA and NIN.

The EMCA is housed at the Core facility Cellular Imaging within the department of Cell Biology&Histology at the AMC. At the EMCA the operators and researchers from the different universities and institutes work on the various TEM and SEM microscopes and have shared work-discussions. The shared equipment is paid for by the involved partners as well as by various other academic and industrial users and clients. As such we collaborate with most Amsterdam and various (inter)national research groups and have created an EM knowledge center in Amsterdam. We have long standing expertise in transmission electron microscopy (TEM), scanning electron microscopy (SEM), but also apply new developments such as combined light electron microscopy (CLEM), tomography, immunoEM, and Cryo-EM.

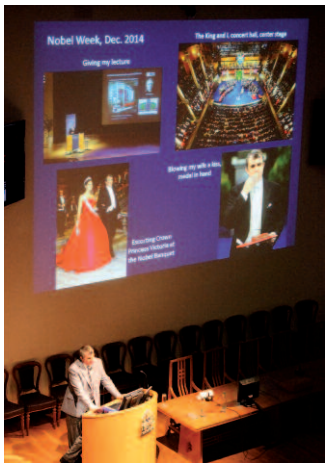
For more information please visit our website:
www.cellularimaging.nl/electron-microscopy

Dr. Nicole N van der Wel
Head Electron Microscopy
Center Amsterdam core facility Cellular Imaging



THE 2ND ESRIC SUPER-RESOLUTION SUMMER SCHOOL 2014, EDINBURGH, SCOTLAND

Nobel Laureate welcomed to Edinburgh to inform and inspire researchers from across the globe.



Microscopy enthusiasts from across the world came together in Edinburgh this summer to participate in the second ESRIC Super-Resolution Summer School. Speakers included Dr Eric Betzig, from Janelia Farm, USA, who won the 2014 Nobel Prize in Chemistry for his pioneering work in the development of super-resolution microscopy. The 5-day residential course aims to educate on the theory and application of super-resolution techniques through informal seminars and practical workshops, as well as promote open discussion and networking across the microscopy field through panel discussion and social events. The pioneers of super-resolution microscopy, leading scientists that are continuously pushing the limits of super-resolution techniques and the biological applications, came from across the globe to teach during the course and left the next generation of microscopists truly inspired. Participants were able to reinforce the theory in practical sessions, ran by ESRIC's industry partners, being able to get hands-on with their own samples, gaining practical tips and guidance for their own research. A highlight of the course this year was the ESRIC Summer Lecture, given by Dr Betzig at the Royal College of Physicians. The lecture was met with an overwhelming response from students and public alike with the 300-seated auditorium selling out within 24 hours. Dr. Betzig gave an inspirational and thought-provoking talk on his journey from academia, to industry and back again, showcasing some of the revolutionary work he and his collaborators have done and the jaw-dropping microscopy recordings he has generated. The take home message being that the best is yet to come! The ESRIC Super-Resolution Summer School was met with overwhelming enthusiasm from all participants, with fantastic discussions looking critically at the issues still surrounding super-resolution microscopy and forging connections across institutes and disciplines that can only lead to further advancement in the field of microscopy.

"Keep this programme running forever ! Its a big inspiration to upcoming scientists." Participant, Sweden

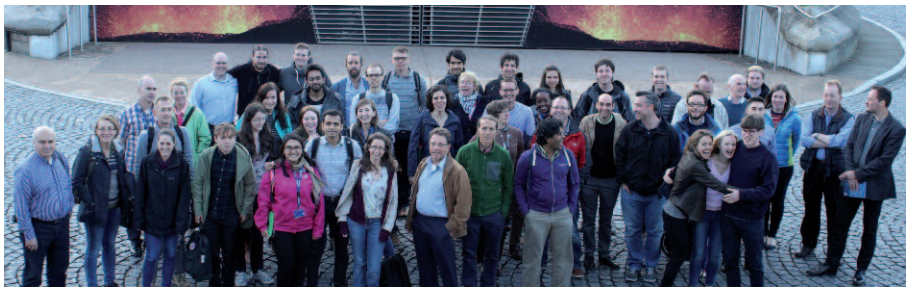
"I liked very much that we had participants from very different fields and with different backgrounds; a wonderful opportunity to look at your scientific question from a different angle." Participant, Poland

The residential summer school is organised by the Edinburgh Super-Resolution Imaging Consortium (ESRIC), a multidisciplinary collaboration between the Institute of Biological Chemistry, Biophysics and Bioengineering (**IB3**) at **Heriot-Watt University** and the MRC Institute of Genetics and Molecular Medicine (**IGMM**) at **the University of Edinburgh**. The open access facility provides a platform for researchers from anywhere in the world to access state-of-the-art microscope systems and expertise to push the boundaries of light microscopy and study human biology and disease.

The ESRIC Summer School was organised in collaboration with Olympus UK and was also sponsored by Bioaxial, Hamamatsu, Leica, Nikon and Zeiss.

Registration for next year's Super-Resolution Summer School will open early 2016 and you can join our mailing list by visiting the ESRIC website www.esric.org.

Dr. Alison Dun
Technology and Facility Manager
Edinburgh Super Resolution Imaging Consortium (ESRIC)
Heriot-Watt University - Edinburgh - EH14 4AS

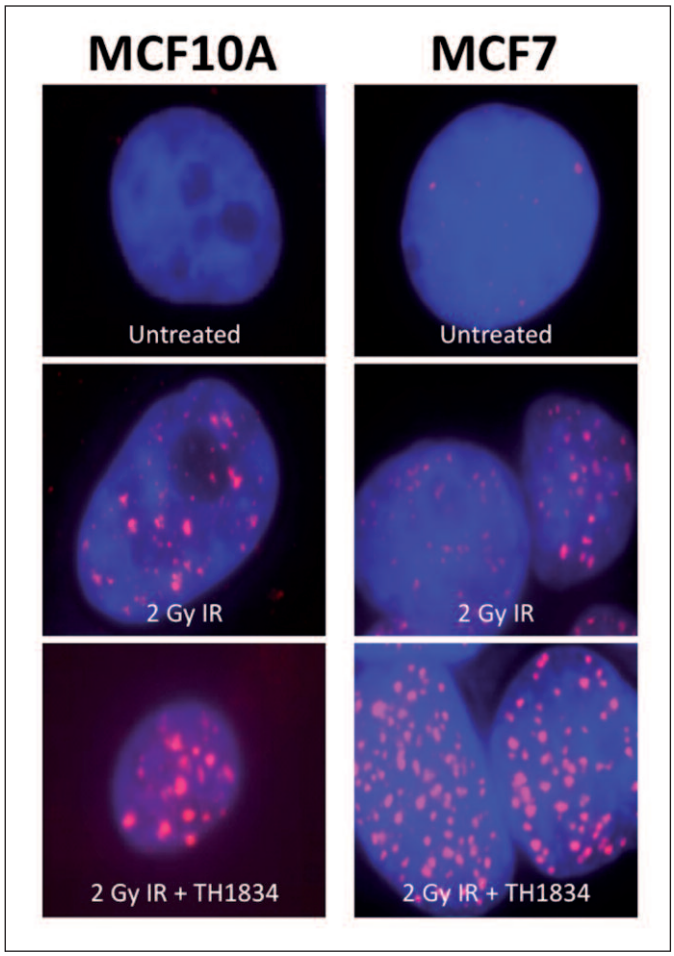


EACR YOUNG INVESTIGATOR AWARD 2015 FOR JAMES BROWN

EACR Young Investigator Award 2015 for James Brown

Dr James Brown (Discipline of Surgery, National University of Ireland Galway) was awarded the prestigious EACR Young Investigator Award 2015 at the Irish Association for Cancer research meeting (February 2015) for his ground-breaking research into a new class of drugs targeting breast cancer. Dr Brown led a team of national and international collaborators that designed and produced a novel drug that specifically targets, and kills, breast cancer cells. Dr Brown hopes that newly designed drug has the potential to one-day aid in the treatment of breast cancer in patients.

Dr Brown being presented with his award by Mr. Rob Kenney from the European Association for Cancer Research.



TH1834 inhibition of Tip60 dependent signalling differentially affects control and cancer cells. Left: pre-treatment (1 hr) with 500 mM of TH1834 inhibits gamma-H2AX 2Gy IR induced IRIF in MCF10A control non-tumorigenic myoepithelial cell line. In contrast, (Right) breast cancer cell line MCF7 pre-treated with TH1834 (500 mM) prior to 2 Gy IR leads to induced gamma-H2AX IRIF. Gamma-H2AX (Red) and DNA (Blue).

DIFSOFT
25-27 SEPTEMBER 2015, DOSLONCE, POLAND

Workshop on Software for TEM Diffraction Patterns Analysis

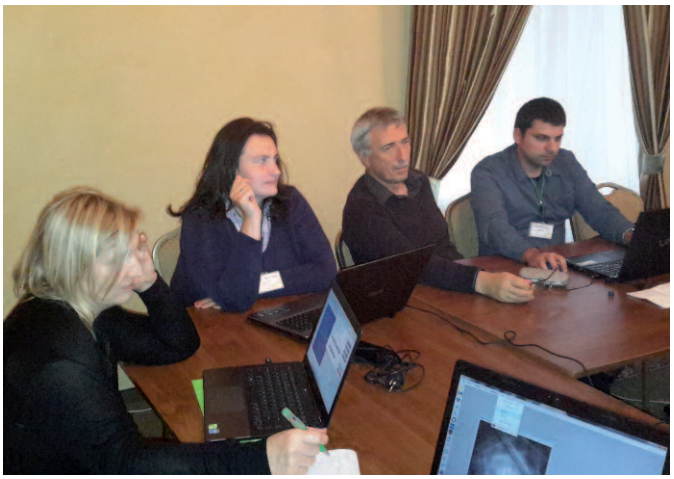
The DifSoft Workshop on Software for TEM Diffraction Patterns Analysis, was held from the 25th to the 27th of September 2014 in the Mercure Racławice Dosłonce Conference & SPA**** which is situated about 50 km from Krakow in the vicinity of the historical village Racławice. It was organized by the Institute of Metallurgy and Materials Science of the Polish Academy of Sciences with support of the Polish Society for Microscopy (PTMi), CrystOrient-K.Sztwiertnia company and LabSoft company. It was attended by 25 participants from different Polish scientific institutions.

The Workshop was focused on TEM diffraction software and its application in materials science. It consisted of short introductory lectures and tutorials of three kinds of software dedicated to diffraction patterns in TEM. Process Diffraction by J. Labar, TEMStrain by A. Morawiec and KikSPot provided by the CrystOrient-K.Sztwiertnia company.

The Workshop provided an opportunity to exchange knowledge and experience from the field of diffraction pattern analysis and software and support for young researchers in their investigations.

From the other side the ideas and suggestions from the Workshop participants will help to improve the possibility and functionality of the available software. Next meetings are planned to be organized.

Magdalena Bieda,
Krzysztof Sztwiertnia and Jerzy Morgiel



PRACTICAL COURSE IN ADVANCED 3D MICROSCOPY 2015 (JANUARY 18 – 23, 2015) ZURICH, SWITZERLAND

This advanced microscopy course is intended for PhD students and post-graduates with prior experience in microscopy. The goal of the course is to teach and train fundamental knowledge and skills in a specific microscopic technique. A series of lectures on the first day (Sunday) focused on the fundamentals of light and electron microscopes, their function and the required preparation procedures to bring all participants to the same level of theoretical knowledge.

The day was concluded by a dinner giving opportunity to the participants to get in touch and to compare notes with each other. Additional lectures were held on selected, advanced imaging techniques and image processing during the following week.

The main emphasis, however, was placed on the practical part during which the students were performing own experiments and in which they were trained in a specific application/technique they had to select prior to the course out of 9 different modules, such as confocal laser scanning, super-resolution light microscopy, life cell microscopy, transmission as well as scanning electron microscopy including immunolabelling, 2D, 3D and cryo techniques.

Results produced during the lab time was presented by the different groups to all other participants on the last day in a final plenary session. In the middle of the course companies in the microscopy field presented their new achievements and developments in short talks during half a day. The following social dinner gave additional time for networking between participants, teachers and company representatives.

Andres Kaech

PAPER AWARDS FOR 2014

The EMS Outstanding Paper awards for 2014 were chosen from a strong field of entries and were awarded by Professor Rik Brydson (the Chair of the Jury of six judges) at the Congress Dinner of the EMS extension Microscience Microscopy Congress 2015 on July 1st in the Midland Hotel at Manchester, UK. The winners received a metal-on-wood plaque plus a prize of 1.000 Euro.

Details of the winning entries are:

- **Instrumentation and Technique Development - Maryam Khoshouei**

'Volta potential phase plate for in-focus phase contrast transmission electron microscopy'.
R. Danev, B. Buijsse, M. Khoshouei, J. M. Plitzko and W. Baumeister; Proc. Natl. Acad. Sci. 111, 15635-15640 (2014); doi: 10.1073/pnas.1418377111

Maryam Khoshouei (accepting the prize for Radostin Danev)

- **Life Sciences - Sharon G Wolf**

'Cryo-scanning transmission electron tomography of vitrified cells'.
S. Grayer Wolf, L. Houben and M. Elbaum; Nature Methods 11, 423-428 (2014); doi:10.1038/nmeth.2842

Sharon G. Wolf

- **Materials Sciences - Reza Zamani**

'Polarity-Driven Polytypic Branching in Cu-Based Quaternary Chalcogenide Nanostructures'.
R. R. Zamani, M. Ibáñez, M. Luysberg, N. Garcia-Castelló, L. Houben, J.D. Prades, V. Grillo, R. E. Dunin-Borkowski, J. Ramón Morante, A. Cabot and J. Arbiol; ACS Nano 8, 2290–2301 (2014); doi: 10.1021/nn405747h

Reza Zamani

EMS SCHOLARSHIPS

SCHOLARSHIP LIST

MCM2015, Eger, Hungary

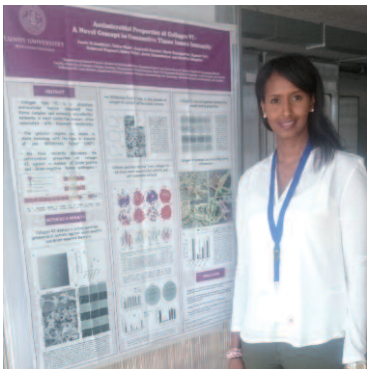
Name	Lab & Country
Abdillahi Suado M	Department of Clinical Sciences, Lund University, Sweden
Battistelli Michela	Department of Earth, Life and Environmental Sciences, Urbino, Italy
Bily Tomas	South Bohemia University, Ceske Budejovice, Czech Rep
Curzi Davide	Department of Earth, Life and Environmental Sciences, Urbino, Italy
Dujmović Ivana	Faculty of Philosophy, Education department, University of Split, Croatia
Kiss Ákos Koppány	University of Pannonia, Doctoral School of Molecular- and Nanotechnologies, Budapest, Hungary
Kolonits Tamás	Institute of Tehcnical Physics and Material Science, Hungarian Academy of Sciences, Budapest, Hungary
Lainović Tijana	University of Novi Sad, Faculty of Medicine, School of Dentistry, Novi Sad, Serbia
Plodinec Milivoj	Laboratory for molecular physics, Ruđer Bošković Institute, Zagreb, Croatia
Salucci Sara	Department of Earth, Life and Environmental Sciences, Urbino, Italy
Schrenková Jana	Laboratory of Electron Microscopy Biology Centre of ASCR, Ceske Budejovice, Czech Rep
Skoupý Radim	Institute of Scientific Instruments of the ASCR, Brno, Czech Rep
Strnad Martin	University of South Bohemia, Molecular Biology and Genetics, Ceske Budejovice, Czech Rep
Torrisi Alfio	Institute of Optoelectronics, Military University of Technology, Warshau, Poland
Venturi Federico	Dipartimento FIM, University of Modena and Reggio Emilia, Italy
Vezzoli Elena	University of Milan, PhD school in Experimental and Clinical Pharmacological Sciences , Italy
Višnjar Tanja	Institute of Cell Biology, Faculty of Medicine, University of Ljubljana, Slovenia
Yaprak Sarac Elif	Department of Histology and Embryology, Istanbul Faculty of Medicine, Turkey

mmc2015, Manchester, UK

Name	Lab & Country
Almeida Trevor P.	Dept of Earth Sc and Engineering, Imperial College London, UK
Banerji Oishik	Dept of Molecular Biology and Biotechnology, University of Sheffield, UK
Clark Laura	EMAT - Dept. of Physics - University of Antwerp
Dohr Judith	Department of Materials Science, University of Oxford, UK
Gkanatsiou Alexandra	Physics Department, Aristotle University of Thessaloniki, Greece
Gonnissen Julie	EMAT - Dept. of Physics - University of Antwerp
Jones Lewys	Department of Materials, University of Oxford, Oxford UK
MacArthur Katherine	Elizabeth Materials Science at Trinity College, Oxford, UK
Marsden Alex	Department of Physics, University of Warwick, UK
Miller Helen	Department of Physics, University of York, UK
Plumhoff Berit	Faculty of Engineering and Environment, University of Southampton, UK

SHORT REPORTS

Suado ABDILLAHI (Sweden)



First of all, I would like to thank EMS for granting me a scholarship to attend the 12th Multinational Congress on Microscopy (MCM), which was held in Eger, Hungary, from 23th to 28th September 2015. I was very happy with the organization and execution of the congress. The congress began every day with plenary talks on cutting edge research, which then was followed by parallel sessions. The presentations were divided into smaller symposia with various topics, which showcased state-of-the-art microscopical techniques currently used in life and materials sciences. It was an enormous opportunity for me to be part of this since most of our research relies on the implementation of different electron microscopy methods.

During the MCM, I had the opportunity to present a poster covering my current project. **It was rewarding to be able to contribute to the congress, and I felt a real sense of achievement about my accomplishments during my last year of my PhD**. Several international researchers within this field were present and available during poster sessions to comment and question my data but also helping to identify future questions.

The MCM presented an opportunity for me to establish key international contacts with participants from a variety of research backgrounds interested in similar types of microscopes.
Overall, participation at the 12th MCM was truly an excellent experience. The feedback I received was both stimulating, encouraging and gave me new ideas about my research. I would like to thank EMS for this great worthwhile opportunity.

Oishik BANERJI (UK)

The Royal Microscopical Society (RMS) and the European Microscopy Society (EMS) held the first Microscience and Microscopy Conference incorporating the Electron Microscopy and Analysis Group in Manchester this year. I had attended the mmc2014 last year and found it very informative. This year was no exception. My presence at the congress was sponsored very generously by a scholarship from the EMS.

Being a PhD student using microscopy techniques, combining atomic force microscopy and high-resolution electron microscopy, the mmc is a major event in my calendar. My project mainly concerns the important nosocomial pathogen, Clostridium difficile, which causes antibiotic-associated diarrhea and life-threatening pseudomembraneous colitis. I presented a poster in the advanced EM session and received very useful feedback for my work.

I was looking forward to the plenary talk by Prof Dirk van Dyck, on his 'Big Bang Theory' of electron channeling for three-dimensional structure determination using HRTEM. I attended the SPM session focusing on biological specimens. I especially enjoyed the talk about AFM to measure stiffness and mechanical properties of diving bacterial cells by Richard Bailey. Also of interest were the sessions of combined microscopies and the talk on the use of AFM to map surface stiffness of influenza viruses by Iwan Schaap. He described the use of AFM, along with fluorescent probes, to detect the release of nuclear material as the virus infects a host cell.

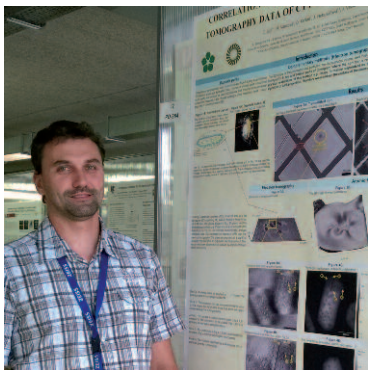
I was very keen on attending the session on Electron Microscopy: from Molecules to Cells. Recent advances in the field of EM have been possible due to the emergence of improved direct electron detectors. These have allowed scientists to look at biological samples with unprecedented detail. One of the challenges that biologist's face, when using EM, is the near instantaneous sample damage due to electron radiation and sample movement. The recent innovations, as described by Chris Russo, from

Cambridge, in his talk on radiation-induced motion, have progressed the field considerably. The use of specially made gold grids improves sample stability by a factor of 50. Also of interest to me was Morgan Beeby's talk on cryo-tomography and understanding the evolution of bacterial flagella system.

The training sessions available for novice users or scientists who wish to venture into an unfamiliar microscopy technique were really helpful. I have benefitted greatly from the SPM learning session this year. In addition to these introductory learning sessions, an enormous area is dedicated to exhibitions by leading manufacturers, all hoping to attract delegate's attention with the latest innovations in imaging technology. The exhibitors were happy to help regarding any specific problems that might be affecting a specific measurement or application. The exhibitors also showcased their products in short lunchtime seminars.

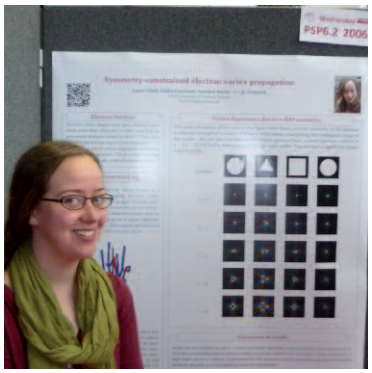
The mmc2015 was a very successful event. A great organizational effort might have gone into this and must be commended. I thoroughly enjoyed this year's event and hope to come back to it next time.

Tomas BILY (Czech Republic)



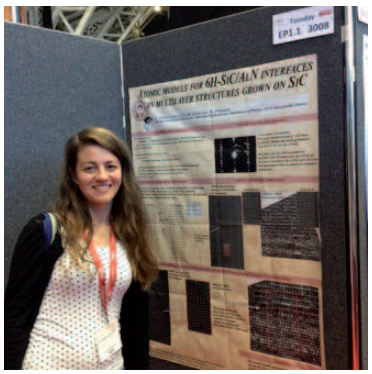
At first, I would like to thank the EMS for financial support which enabled me to attend the MCM2015. The congress held in Eger was a great opportunity to present my early results. I enjoyed discussions about my work during the poster session and I was motivated to extend my plans for my future experiments. To me the congress talks were very inspirational, especially the ones on electron tomography and atomic force microscopy. **I've made a new contact with a colleague who gave a talk which has grown into collaboration**.
The Hungarian university town Eger has impressed me by its historical buildings, parks and the town centre. I tried out the traditional thermal baths and wine. Once again thanks to EMS for the opportunity to participate on MCM2015.

Laura CLARK (Belgium)



Thanks to the support of the EMS, I was able to attend the MMC/EMAG 2015 conference in Manchester this summer. This conference was very interesting to me, and gave a refreshing reminder of the microscopy that exists outside of my thesis-bubble. This year was the first time that I have seen these two conferences have joined, which lead to a fortuitous combination of symposia for my interests.
Particular highlights for me, included the advanced electron microscopy techniques symposium, with talks on both theory, and applications of electron vortex beams; and also the symposium on electron microscopy of magnetic and structural materials, which demonstrated the broad array of tactics currently being employed to approach this challenging topic.
As seems to be a hallmark of the EMAG conferences, the poster sessions were well integrated into the event, and a place of many vibrant, and cross-disciplinary discussions. I'm looking forwards to the next one already!

Alexandra GKANATSIOU (Greece)



This was the first year that I attended the Microscience Microscopy Congress (mmc2015) held in Manchester and I was really impressed.

The whole event was organized extremely well, incorporating a wide variety of topics in the daily program, giving us extra knowledge about the "state-of-the-art". The workshops, as well as the learning zone, gave us the opportunity to learn things and get informed about recent progress in many microscopy fields. The exhibition was really interesting. There

were lots of exhibitors giving us access to a plethora of opportunities to enhance and advancing our knowledge base and skillset.

Moreover, **I enjoyed getting in touch with so many interesting people from a wide variety of different countries and discussing about any improvements and successes in different micro scientific fields**.

In conclusion, attending the mmc congress proved to be a valuable experience, in terms of meeting scientists throughout the world, having the opportunity to attend a variety of meetings and discuss different topics. The conference also helped to provide me with new ideas as well as new and of course better ways of thinking for the future.

It was, in total, a unique experience!

Julie GONNISSEN (Belgium)

I would like to start by expressing my sincerest thanks and appreciation to EMS for the financial support, which made it possible for me to attend the mmc2015 conference, incorporating EMAG 2015 in Manchester. It was the first time for me that I could give an oral talk at a conference and it has been a great experience. I presented recent results of our abstract entitled "Optimal experiment design for atom-counting in atomic resolution TEM and STEM: possibilities and limitations to the precision in both imaging methods", and I got some great feedback afterwards. I enjoyed the plenary lectures across the four days, and the many other presentations of starting and experienced scientists were also very interesting for me. I mostly followed the lectures about the topics that were included in the EMAG conference, so I always had the choice between at least two interesting talks.

The poster presentations were also very useful and gave me the chance to meet other people that are working in the same area. The fact that EMAG was incorporated in mmc resulted not only in a vast number of presented posters, but also in a large and interesting exhibition, where we could meet other scientists and discuss our research.

Since the conference took place in the big Manchester Central we were really close to the city centre, which allowed us to visit Manchester and enjoy some nice local food and drinks after the intense days at the conference. There were also some social events organised like the welcome reception, the EMAG dinner and the conference banquet, where we could talk with our colleagues in a friendly and great atmosphere. For all of this I would like to thank EMS again since overall, this conference was a rich experience for my professional and personal progress.

Jana SCHRENKOVA (Czech Republic)

Thanks to the European Microscopy Society´s financial support, I was given a great opportunity to attend the 12th Multinational Congress on Microscopy that was held in Eger, Hungary. As the first international conference I have ever attended, the MCM2015 was really special for me. I had a chance to attend many interesting lectures that were inspiring for me and provided me a fresh insight into my research. Apart from these, I also attended lectures from different branches of electron and light microscopy, enabling me to broaden my scientific background.

Although the MCM2015 was not comparable to IMC2014 regarding the number of lectures and participants, its "family" nature allowed me to meet many authorities in the field and to discuss common topics with them. In addition to this, I was allowed to present my work via a scientific poster. During the poster session, I was given many objections and comments that were beneficial for my further work. Last but not least, the non-scientific part of the congress was also unforgettable. Eger offers not only delicious wine and thermal baths, but it is also an amazing town with a beautiful cultural life and historical monuments.

To sum it up, **the MCM2015 exceeded all of my expectations and I´ll always remember it as another awesome microscopic event. Thank you!**

Ákos Koppány KISS (Hungary)

I am really glad that EMS has supported my participation at MCM2015, the 12th Multinational Congress on Microscopy in Eger. As I had received really new and inspiring ideas at IMC2014 in Prague last year, I was happy to get the opportunity to present my latest results in Eger this year.

I held an oral lecture, which was a good chance to improve my skills about talking to people coming from different countries with different ranges of interest.

The conference was organised professionally and also the social programs were perfect. Two main personal successes of this conference were that I experienced other people's interest of my topic and, consequently I could get to know professors, postdocs and PhD students from around the world.

Tamás KOLONITS (Hungary)

First of all, I would like to congratulate the EMS with the good decision about my financial support. My participation at the conference MCM2015 was so beneficial for me (and I hope it was also for others).

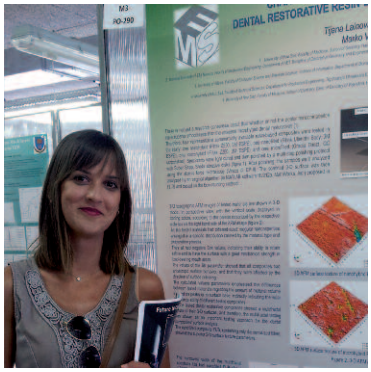
Many ideas about my current and future researches were inspired by the lectures and posters. I think that I had reciprocated a part of this under the poster sessions: discussions occurred and business cards were exchanged with many colleagues in front of mine or their posters. I hope this will lead to some international cooperations.

I am very pleased that my poster was selected for the Best Poster Award within the category of Materials Sciences (M1-M7). It is a strong motivation to continue my research activities on this field.

Speciality of the conference was an open discussion with the plenary lecturers and other invited speakers. It was a great opportunity for young scientists to discuss about not just the topics of the lectures but it was a possibility to ask those questions that are of concern to young PhD students.

Thanks to EMS again for granting me a scholarship and to the organizers for their excellent management. I hope it will be repeated next year in Lyon.

Tijana LAINOVIĆ (Serbia)



The 12th Multinational Congress on Microscopy – EMS extension 2015 was held in Eger, Hungary, from 23-28th August. It had over 400 participants and a very rich scientific program in the fields of microscopy instrumentation and technique, life sciences and materials sciences. The plenary and invited lectures, but also the posters were of a high scientific quality, and were presented by the leaders of various microscopy research fields.

The European Microscopy Society (EMS) supported me to be part of such a well-organized conference by providing me an early stage career scholarship, and thus, gave me the opportunity to attend and to actively participate in it.

I learned a lot about the emerging technologies related to the contemporary microscopic techniques and heard a lot of interesting new approaches in the microscopy research fields. It was very inspirational to hear the specific lectures which were closely related to my research experience. I expanded my knowledge, met many great people, and made a new research connections which could help me in my further career development.

I visited the great exhibition and saw the presentation of the newest microscopic technologies which gave me the inspiration to maintain my research efforts in the following year.

I presented my work on AFM and multifractal analysis of dental restorative nanocomposites during a poster session, and I was pleased to have the opportunity to share my experience with other researchers, from various fields, who enriched my view on the problem by looking at it from different perspectives.

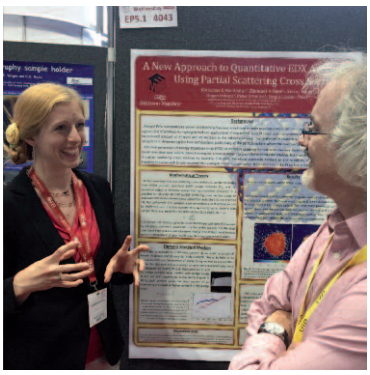
That is a beauty of microscopy, many different objects and scientific problems can be analysed and solved by using the mutual microscopy tools which are getting better and better every year.

Since I am a doctor of dental medicine, I could not imagine that I would be a part of the microscopy society one day. But the EMS gave me the filling of the full affiliation to this society and respected my working efforts.

I want to emphasize my great gratitude to the EMS which supported my MCM2015 visit.
Wishing EMS a great success in the upcoming years… Warm regards,

Katherine MACARTHUR (UK)

mmc2015 was held in Manchester Convention Centre from 29th June to 2nd July which incorporated the IOP biannual meeting of the electron microanalysis group (EMAG). I was lucky enough to be granted both an oral and a poster presentation by the organisers, for which I am very grateful.



This is the 3rd EMAG conference I have attended since beginning my scientific research career. I always enjoy EMAG as a very friendly and approachable conference. It is a very supportive environment particularly good for someone new in the field presenting their first talk or for presenting new unpublished results. I was worried that the amalgamation into a much larger congress would cause this friendly atmosphere to be lost. Thankfully this was not the case despite having over 1300 congress delegates. The questions I received in my talk were all mostly suggestions for future work and I had some very enjoyable debates around my poster as well. **The conference was very well organised and I rarely found myself running back and forth between multiple sessions**.

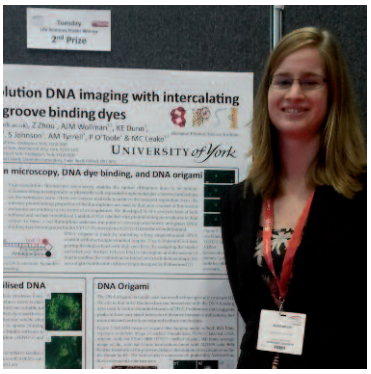
I am very grateful to the EMS for helping me to attend this conference. Particularly as it was my final summer as a student and so my funding was running very low.

Alex MARSDEN (UK)

Firstly, let me thank the EMS for the scholarship to help with the costs of travelling to Manchester for mmc2015. The conference was packed with presenters and commercial exhibitions that made a packed experience. There were also some excellent plenary speakers: a personal highlight for me was Max Haider, who gave a talk on the history and current landscape of aberration correction. It is always fascinating to see how far these topics have come, especially when this is presented by someone who has been following them from the beginning.

As part of the conference, I presented my work on using electron microscopy to understand the structure of vanadyl phthalocyanine (an organic semiconductor that could be used in organic solar cells) deposited onto graphene at elevated temperatures. I had many interesting discussions with people, particularly around the topic of using electron microscopy to study these beam-sensitive materials. This is an area that I am just starting in, and so it was very helpful to get the input of others on these topics. **I was also pleasantly surprised to win 2nd place in the EMAG poster competition, for which I am thankful to the organisers.**
Overall, I felt the conference was a very successful trip and I got a lot out of all the many activities. This would not have been possible without the financial support from the EMS, and so I am most grateful.

Hellen MILLER (UK)



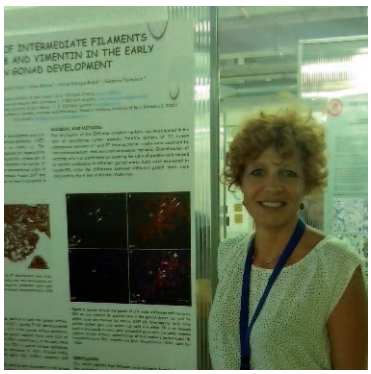
mmc2015 ran from the 29th of June to the 2nd of July in an unexpectedly hot Manchester. Inspiring plenary talks across the range of topics covered at the conference and fascinating detailed talks across the parallel sessions meant I left with many new ideas and a lot of enthusiasm.

I enjoyed presenting my own work on super-resolution imaging of DNA with a poster, and had many interesting and stimulating discussions with people about DNA binding dyes, super-resolution software and DNA origami. **I was honoured to receive second place in the Tuesday Life Sciences category**.

I attended mostly the 'Frontiers of bioimaging' sessions, and found the super-resolution microscopy session particularly engaging; here the topics covered everything from clustering analysis methods to new microscope setups. I found the talk from Gail McConnell on standing wave fluorescence, which produces a contour map in the image, particularly interesting.

I would like to thank the European Microscopy Society (EMS) and the Royal Microscopical Society (RMS) for their financial support which enabled me to attend this meeting.

Ivana RESTOVIĆ (Croatia)



Attending Multinational Congress 2015 in Microscopy in Eger, Hungary from 23 – 29 August was very nice and useful experience, both professionally and socially. The host gave a great effort to organize interesting plenary lectures starting with Peter Somogy from Oxford University, UK, followed by other great plenary lectures in both, materials and life sciences. Especially, I was proud that my Croatian colleague, Iva Tolić was invited as plenary speaker together with some great names like Velimir R. Radmilović / University of Belgrade, Serbia, Toyoshi Fujimoto / Nagoya University Graduate School of Medicine, Japan, Jannik C. Meyer / University of Vienna, Austria.

In the life sciences section that I was attending, there were many interesting and useful lectures, where you could learn a lot new facts about the microscopy world exploration in different fields. I was glad to see many young scientists presenting their work, as poster or oral presentation. Among the exhibited posters, I have found a similar topic to my research and made a few interesting and debating conversations which will improve my research and certainly influence my work. **Special compliments to the MCM2015 committee for organizing open discussions between speakers and young scientists.**

During the poster presentation, I participated in several interesting talks which could yield, which I certainly hope for, in future collaborations. I have to say, there were many interesting poster presentations, so it was no surprise for me to see, at the Closing ceremony so many awards to the young scientists.

In the exhibition hall many innovative and new microscopy equipment could be seen to which you could be introduced within the many workshops organized by different microscopy companies. Since Hungary is known by many different kinds and sorts of wine, I especially have to mention the JEOL representative, who organized a wine tasting evening, where we had a very nice and amazing time.

I want to congratulate the Organizing comity of MCM2015 for organizing a great congress and special thanks to EMS for recognizing me as candidate for scholarship. Providing scholarships to young researchers is a great deal and support which allows you many opportunities to meet great scientists from all over the world, to learn about microscopy equipment and new techniques and also encourages building yourself in the direction of an innovative and prospective researcher.

Radim SKOUPÝ (Czech Republic)

The Multinational Congress on Microscopy 2015 in Eger (Hungary) was my first opportunity to attend such a great microscopic event. Therefore I would like to thank the European Microscopy Society that allowed me to participate.

The city of Eger has a very long and rich history, a beautiful spa and vineyards all over the city so I think that the place for the congress was chosen very well. Especially as the weather here between Aug. 23 and 28 was perfect.

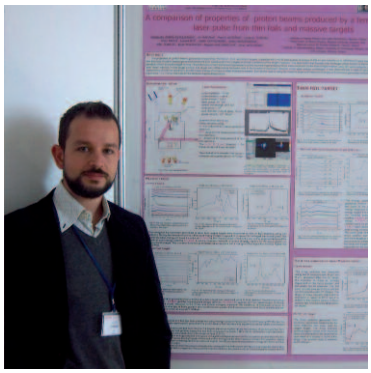
I am a first year PhD student and it was a big pleasure that I had an oral presentation. I was very nervous – the opportunity to present my results in front of colleagues from all over the world was something entirely new for me, but finally it was an amazing experience.

I would like to mention that the entire event was very well organized. All presentations were divided into three rooms lying side by side. So it was very easy to listen interesting speeches from different sections. Mainly the presentations of Eyal Shimoni from Israel and Toyoshi Fujimoto from Japan were amazing.

I met many young scientists and other experts in the field of microscopy. **This participation became a great asset for me and an inspiration too**. Overall, I enjoyed the conference and I'm looking forward to the next congress.

Alfio TORRISI (Poland)

I am a PhD student at the Institute of Optoelectronics (IOP), Military University of Technology (MUT), Warsaw, where I am working at the Extreme Ultraviolet and Soft X-ray Nanoimaging Laboratory. I am involved in the developing of desk-top microscopy systems, operating in the extreme ultraviolet (EUV) and soft X-ray (SXR) spectral range, achieving sub-100nm spatial resolution. The microscopes are based on a compact double stream gas puff target sources, in which the plasma is produced by nanosecond laser irradiation of gaseous targets with high intensity laser pulses. SXR sources emitting in the "water window" region between 2.3 and 4.4 nm wavelengths are very important for imaging of live biological samples. High contrast in this spectral range is obtained due to a difference in absorption coefficient of different constituents of biological specimens. Besides, compact SXR sources give the opportunity to perform the experiments without the necessity to employ large "photon facilities" with limited user access.

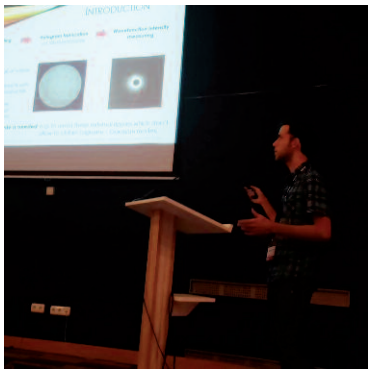


I really want to thank the European Microscopy Society for giving me the opportunity to participate at the Multinational Congress of Microscopy 2015 through a fellowship.

During MCM2015 I presented the results of my research with a talk entitled **Optimization of a "water-window" microscopy based on a compact laser plasma SXR source**, in the section concerning Super-resolution microscopy. I had also the opportunity to present, as co-author, a poster in collaboration with my colleagues from CTU, in Prague, entitled: **Development of a compact "water-window** microscope for the high resolution imaging of biological objects, based on capillary discharge XUV source". Both contributions allowed me to share my knowledge with many experts in microscopy, curious and interested about this field of research that can have numerous applications in biological and biomedical fields.

Moreover, a lot of posters and talks allowed me to meet many scientists and to expand my knowledge about different microscopy technique, as well as to take different ideas for future collaborations.

Federico VENTURI (Italy)

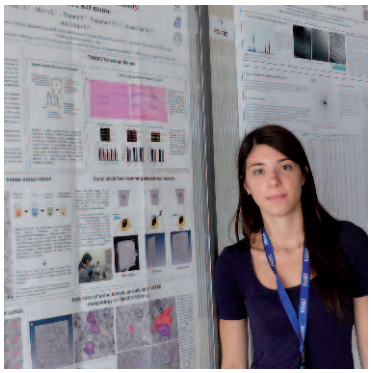


It's been a pleasure for me to participate to the Multinational Congress on Microscopy 2015 in Eger. I got the chance to orally present two studies on very different subjects; one on electron holography and the other on magnetic materials; both have been well accepted by the audience and gave rise to fruitful discussions during and after the presentations.

The multinational environment was stimulating, offering a panorama of the state-of-the-art of microscopy research in Europe and even farther.

It's been a great occasion to getting in touch with people I already knew and to meet new ones, with the opportunity to talk about each other's work. I'm grateful to EMS and SISM (Italian Microscopy Society) for sustaining my presence at MCM2015 with a scholarship and a prize of participation. I'm really looking forward to the next MCM in 2017.

Elena VEZZOLI (Italy)



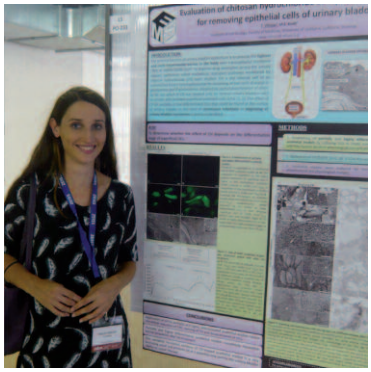
I took part in the Multinational Congress of Microscopy 2015 in the nice and cosy city of Eger.
First of all, I would like to thank the European Microscopy Society (EMS) and the Italian Microscopy Society (SISM) for the financial support, which allowed me to participate in this Congress. This was the first Microscopy Congress for me and it was very fascinating and interesting.

I think that, for a PhD student - as I am -it was a great opportunity to present personal work entitled "A three-dimensional study of dendritic spines using SBFSEM on new animal model of intellectual disability: the TM4SF2 KO mouse". Moreover, the poster session allowed me to have an exchange of views with other PhD students and expert researchers in different fields who were able to give me interesting suggestions and ideas for my future research. During this time in Eger, I followed lectures focused on different microscopy areas that gave me the possibility to learn a wide range of new techniques, instruments and research. **Particularly interesting for me was Serial Block Face imaging and 3D-reconstruction, Cryogenic scanning electron microscopy and the related talks.**

I would like to thank the conference organizers for the excellent organization of all the scientific and non-scientific events during and before the congress: they were very helpful and kind.

I am glad I have had this kind of opportunity, which has been an extremely useful experience for my present and future works.

Tanja Visnjar (Slovenia)



I would like to express my deep gratitude to the European Microscopy Society (EMS) for the financial support, which allowed me to attend the Multinational Congress on Microscopy (MCM2015) in Eger. This really well organized and structured congress was undeniably useful, since it gave me the opportunity not to only attend lectures and talks from the section of live science but also to look beyond the borders and to get an insight in the broad variety of evolving topics in which microscopy is involved in. It was exciting to see how different areas of microscopy are every year more and more connected and at the same time dependent on each other. The broad congress topics really fascinated me and gave me the opportunity to meet leading experts from the field and talk with them in person. These new contacts have opened new opportunities in my future career and expanded collaboration possibilities. In addition, congress workshops with the exhibi-

tions of different companies during the breaks were highly interesting, since new equipment and techniques were presented. I really enjoyed the poster sessions, where I had an opportunity to present my work, discussed the results and found new colleagues. Overall, I strongly recommend young scientists to participate in this congress and once again, I would like to thank the EMS for the financial support and the organizers for their excellent management.

Elif YAPRAK SARAÇ (Turkey)

First of all, I would like to thank the European Microscopy Society (EMS) for the scholarship which allowed me to participate at MCM2015 in Eger. It was the first time that I have been supported by EMS and thus as a member of the society, I am greatly thankful for the support of young scientists.

I had the chance to present a small part of our studies titled as "Short term effect of metformin on proliferation of 3T3 mouse fibroblast cells in hyperglycemic models" in the congress.

I was extremely motivated to add some advanced studies with electron and fluorescence microscopical methods since I had the opportunity to learn more about these fields in MCM2015. In particular, the plenary lecture about 'Correlative microscopy in biology' given by Bruno Humbel and lecture about 'Simultaneous correlative light & electron microscopy of samples in liquid' given by Nalan Liv improved my enthusiasm to look deeply inside correlative microscopical techniques and make some collaborations to gain advanced skills in my academic career, especially during my PhD. I had also the chance to look at state-of-the-art microscopes and accessories, meet colleagues and discuss other people's research during poster sessions and open discussion.

As the event was very well organized and informative, I would like to extend my thanks to the organization committee. **Since oral presentations were divided well, participants were enabled to take some time to enjoy the small city, Eger, and also other touristic places of Hungary**. I fully support and once more am grateful for EMS's efforts in providing scholarships for young scientists, especially for those from developing countries, since their participation in scientific events is often influenced by financial problems.

I hope these efforts will encourage my young colleagues to attend many other events and support their academic career.

Notes :

FINANCIAL REPORTS

EUROPEAN MICROSCOPY SOCIETIES

EUROPEAN CORPORATE MEMBER ASSEMBLY (ECMA)

EMS CALENDAR 2016

APPLICATION FORMS (MEMBERS - ECMA)

Notes :

FINANCIAL REPORT OF EMS BUDGET

Budget 2015 final
Budget 2016 running
Budget 2017 outlook

Budget 2015, final

Incomings
The majority of incomings were the contributions from the national societies and the ECMA members and further incomings came from individual members, interest rates and from job postings for non-EMS members.
In summary, an amount of € 40.604,15 was accrued.

Expenses
EMS supported one extension meeting (MCM Eger) and six sponsored meetings (in sum € 6.500). 29 scholarships were granted to young scientists for their attendance mostly at MMC in Manchester and MCM in Eger (in sum € 7.250). Two board meetings were held, one embedded in the MCM and one extra meeting in February in Lyon (in total € 4 863,94). Three Outstanding Paper Awards added up to € 3.000,00 and together with the costs for a half-time secretary and bank costs we had a total of expenses of € 52.579,17.
In summary, the budget 2015 we ended with a minus of € 11.975,02. At the end of the year we had € 69.256,55 at our savings deposit.
As of December 31st, 2015 EMS had total assets of € 62.170,00.

Budget 2016, running; (as of January 7th, 2016)

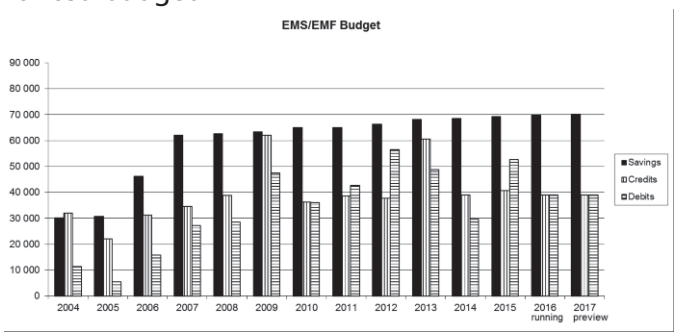
Incomings
The major revenues will again be accrued by the annual contributions of EMS members of the national societies and of ECMA members. Invoices to ECMA members will be sent out in January with payment deadline set for April, 30. Invoices to national societies will be sent out once the updated member list will be available (likely April). Additionally, invoices for membership fee requests will be sent to individual members. Further incomings will be accrued by interest rates and, possibly, by job postings for non-EMS members.
Together, incomings can be expected to amount to € 39.000.

Expenses
There will be no EMS extension meeting this year due to EMC Lyon. EMS will support 4 sponsored meetings (in total € 3.000). EMS will issue 25 scholarships for attendance at EMC (in sum € 6.250). Further expenses will include the Outstanding Paper Awards (€ 3.000), two board meetings (one extra meeting in Antwerp in March and one embedded at EMC), professional secretarial support and bank costs.
Together expenses are estimated to amount to € 39.000.
It is thus calculated to end the year 2016 with a balanced budget.

Budget 2017, proposal

Incomings
Major incomings will be accrued by the annual fees of EMS members of the national societies and of ECMA members. Together with interest rates of the savings account and advertising for non-EMS members we can expect incomings of € 39.000.
Ann.: this year EMS can expect revenues from EMC2016 in Lyon (not yet budgeted).

Expenses
EMS can support one extension meeting and three sponsored meetings (in total € 3.750) and can issue 8 scholarships for travel support (in total € 2.000). Further expenses will include the Outstanding Paper Awards, costs for professional secretary, two board meetings (one extra, one included in a meeting) and bank costs, amounting to a total of estimated € 39.000.
It is thus calculated to end the year 2016 with a balanced budget.



Christian Schöfer, m.p. *Vienna, 8th January 2016*
Treasurer EMS/EMF

EUROPEAN MICROSCOPY SOCIETIES

Number of EMS Members by societies (2015)

Society			*Number of Members*
Armenian Electron Microscopy Society	AEMS	Armenia	8
Austrian Society for Electron Microscopy	ASEM	Austria	167
Belgian Society for Microscopy	BSM	Belgium	312
Croatian Microscopy Society	CMS	Croatia	82
Czechoslovak Microscopy Society	CSMS	Czech Republic	268
German Society for Electron Microscopy	DGE	Germany	371
Electron Microscopy and Analysis Group (Institute of Physics)	EMAG	United Kingdom	314
Hellenic Microscopy Society	HMS	Greece	60
Hungarian Society for Microscopy	HSM	Hungary	111
Israel Society for Microscopy	ISM	Israel	171
Microscopical Society of Ireland	MSI	Ireland	96
Dutch Society for Microscopy	NVvM	The Netherlands	224
Polish Society for Microscopy	PTMi	Poland	100
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15th International Congress of Histochemistry and Cytochemistry

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June 27 - July 02, 2016
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16th European Microscopy Congress

August 28 - September 02, 2016
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