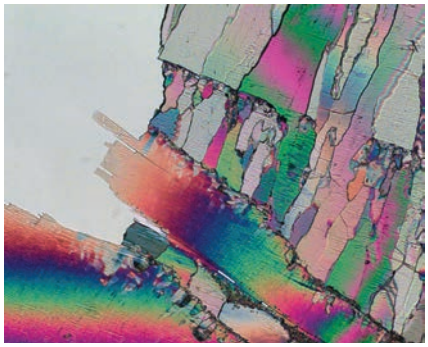

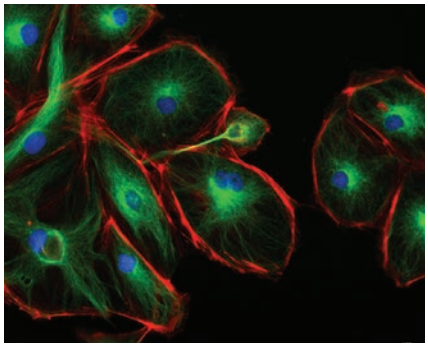

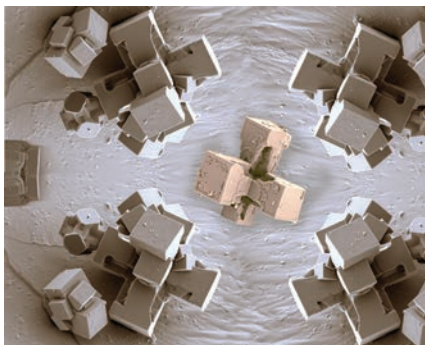

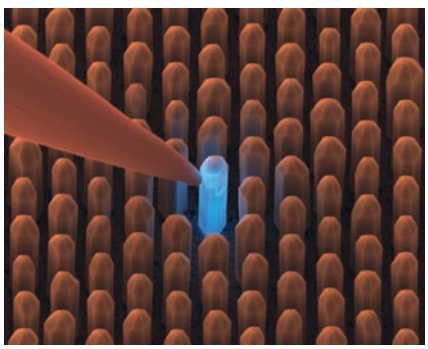

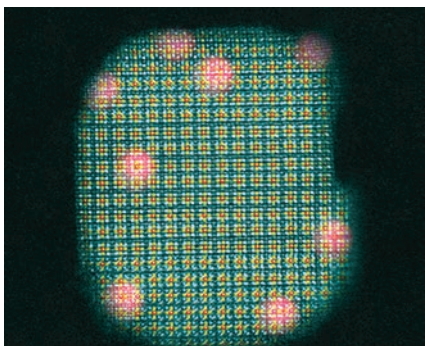

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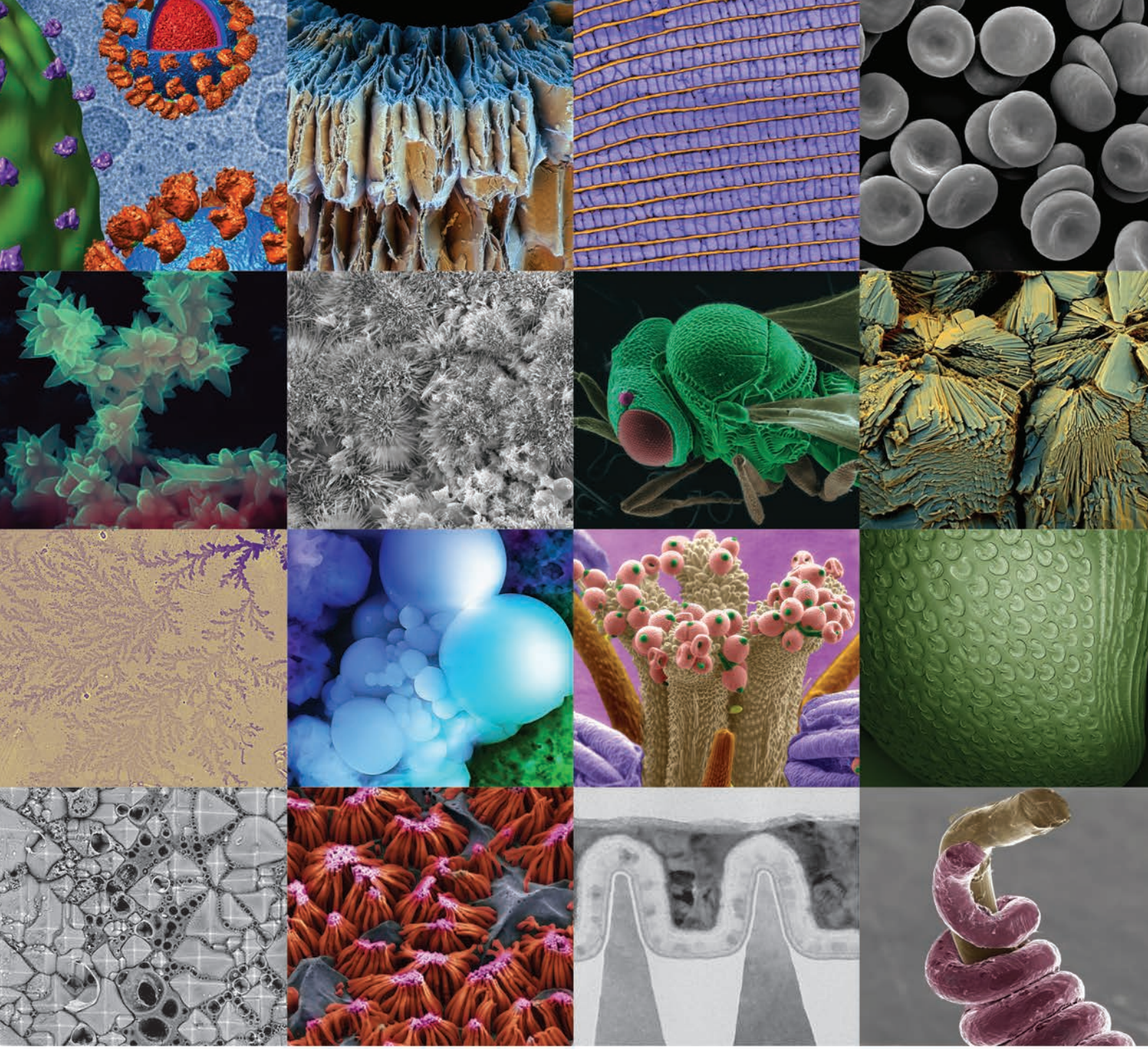

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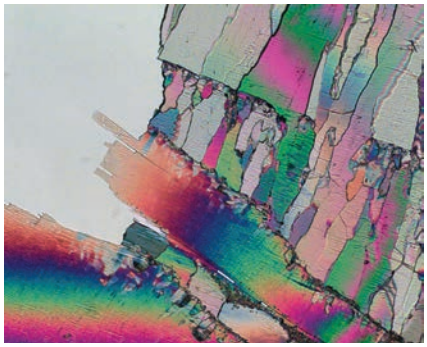

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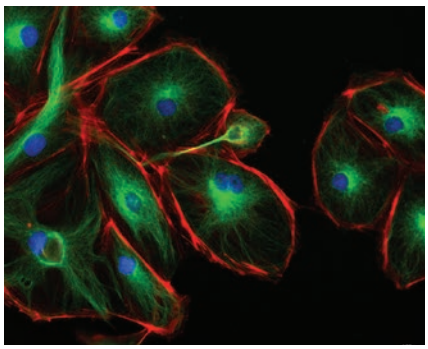

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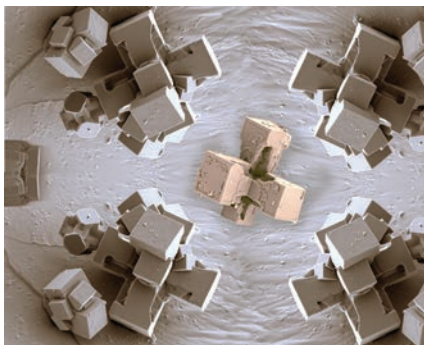

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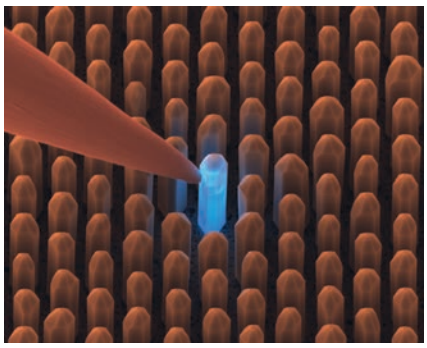

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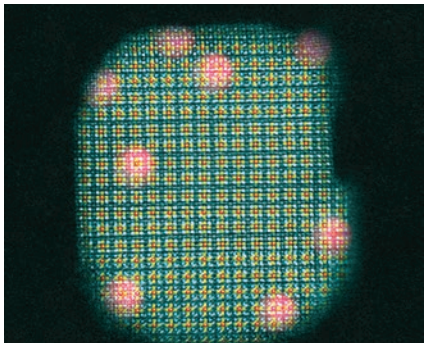

[5]

[6]

European Microscopy Society

CATEGORY 1: PHOTONIC TECHNIQUES (E.G. LIGHT MICROSCOPY IMAGING, CONFOCAL, FLUORESCENCE,...)

[1] *SROT VESNA,*
Max Planck Institute for Solid State Research, Stuttgart, Germany
HEALED ABALONE SHELL
A polarized light optical micrograph from an area across the healed part of the abalone shell. It appears that the shell was damaged during the growth by an impact from the outside. Nacreous aragonite and prismatic calcite are shown on the image. Scale bar represents 200 micrometre.

[2] *BRECHET DAMIEN,*
Biotek Instruments, Winooski, USA
Ptk2 cells (rat kidney) 20x
20x - Ptk2 cells (rat kidney), image taken on Cytation 3 Cell Imaging Multi-Mode Reader. Cells fixed and stained for tubulin (green), actin (red) and nucleic (blue). Image was one of several taken for BioTek application note "High Resolution Fluorescence Microscopy of PtK2 Cells Undergoing Mitosis in Microplates"

CATÉGORY 2: SCANNING ELECTRON MICROSCOPY BASED TECHNIQUES (E.G. SEM, FIB INSTRUMENTS, EBSD, TKD,...)

[3] *BOTHA ANDRE JOHANNES*
Symmetry in the small world : 0.5 KV High resolution FEG SEM micrograph of Heat treated LiF Crystals.

[4] *LEDIG JOHANNES,*
TU Braunschweig, Germany
Micro-lantern inside an ensemble
Light emitting region of a contacted InGaN/GaN core-shell micro-LED inside an ensemble visualized by EBIC (cyan) and SE (orange) imaging showing a view field of 25 µm.

CATEGORY 3: TRANSMISSION ELECTRON MICROSCOPY BASED TECHNIQUES (E.G. CONVENTIONAL TEM, STEM, HRTEM, DIFFRACTION,...)

[5] *BLADT EVA,*
University of Antwerp, Belgium
High resolution HAADF-STEM image of a CsPbI3 perovskite nanocrystal
High resolution HAADF-STEM image of a single CsPbI3 nanocrystal in which the Cs atomic columns are indicated in red, the I atomic columns in yellow and the mixed Pb-I columns in blue. Additionally, Pb clusters can be observed as faint red spheres. The image was acquired using a cubed FEI Titan microscope operating at 300 kV.

[6] *KOLOSOV VLADIMIR,*
Ural Federal University, Ekaterinburg, Russia
Target board (Fe_2O_3)
Amorphous materials are unstable. Local amorphous-crystalline transitions are used for phase-change materials (for information storage, etc.). The micrograph of α-Fe_2O_3 (corundum structure, [0001] is normal to the film plane in the crystal centre) formed in amorphous films (10-50 nm) by local electron beam annealing inside transmission electron microscope (5-200 Kv) demonstrates novel transrotational crystal structure revealed by bend-contour analysis.*

** V.Yu. Kolosov and A.R. Thölén, Acta Mater. 2000, v. 48, p. 1829*

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PREFACE

Dear EMS members,

Our dear colleague Nick Schryvers, former EMS secretary for 12 years, entrusted me with the heavy mission of substituting him, with the aim of developing EMS even further. I'm very honored and pleased to be involved in such a task. Beside our new President, Josef Zweck, together with the motivated board and efficient support of our partner MCO I will do my very best to promote the use and quality of advanced microscopy throughout Europe in all its aspects.

EMS now gathers 25 national and/or regional societies, including more than 5800 members, and 52 corporate members (ECMA). In 2016, more than 250 announcements, job adverts and events, have been included in our newsletters (2 per month) and in the EMS website. So a very rich microscopy year has now passed.

When browsing through this 2016 EMS Yearbook, it will become clear that our field is extremely active with many conferences, workshops, courses…, being organised all over Europe. Reports of many of these events 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 EMC in Lyon, and the papers by the two European microscopy award winners. You will also find a report on historic microscopes, with a focus on the early days of optical microscopy in the 18th century.

While our EMC2016, organised in Lyon, is now over, it was a great and very exciting meeting, the upcoming conference season seems to become also unforgettable, in particular with the two EMS extensions, the Microscopy Conference 2017 (MC) and the 13th Multinational Congress on Microscopy (MCM) to be held respectively in Lausanne, Switzerland, from 21 to 25 August 2017, and in Rovinj, Croatia, from 24 to 29 September 2017. We invite all of you to join us at these occasions.

Many thanks to all colleagues who have contributed to this Yearbook and in particular Nick Schryvers for the proof reading.

Virginie Serin, *EMS Secretary*

Part of the new and past board @ the gala dinner, Lyon, EMC2016 (from left to right: Nick Schryvers, Roger Wepf, Thierry Epicier, Paul Midgely, Christian Schöfer, Randi Holmestad, Stefan Kuypers, Rick Brydson, Virginie Serin, Serap Arbak, Josef Zweck, Joachim Mayer).

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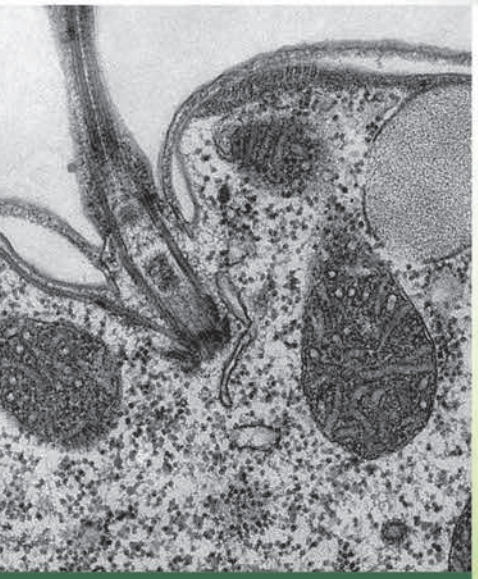

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LETTER FROM THE PRESIDENT

...

Dear EMS members and fellow microscopists,

You hold the latest edition of the EMS Yearbook in your hands. You will notice that the front cover is a compilation of the winning pictures of the image contest, conducted during EMC2016. It nicely represents the variety of topics and disciplines which are represented in our society. As you are accustomed to previous editions, it contains information about EMS activities from the last year, including awards and congresses, and indication of future events. As for the awards, you will find condensed versions of the award lectures of the winners of the quadrennial European Microscopy Award, which has been sponsored by JEOL. The winners are **Dr. Angus Kirkland**, Oxford (Materials Science) and **Dr. Niels de Jonge**, Saarbrücken (Life Sciences). The award lectures have been given during last year's splendid EMC2016 conference, and if you did not have the chance to be there in person, this is your chance to learn what the award was all about.

After having mentioned the EMC congress here I would like to point to the fact that – even though the congress is over by now – it is still worthwile to visit the conference webpage *http://www.emc2016.fr/en/* where you can experience "A short trip back in EMC2016", giving you an impression of the preparation work which preceded the congress and of the gala dinner's events. You may also want to browse a photo album and enjoy the conference in retrospective or browse the proceedings, which are completely available online!

Further, I would like to draw your attention to the numerous occasions, where you can apply for special support by the EMS, such as the EMS extensions, sponsored events and patronaged events. Details can be found on the EMS website *http://www.eurmicsoc.org/en/meeting-calendar/*. Last years supported events have been :

• EMS patronaged events:

- 5th Stanislaw Gorczyca European School on Electron Microscopy and Electron Tomography (Krakow – Poland)

• EMS sponsored events:

- Conference on In-Situ and Correlative Electron Microscopy - CISCEM 2016 (Saarbrücken – Germany)
- International School on Fundamental Crystallography with applications to Electron Crystallography (Antwerp – Belgium)
- Quantitative Bioimaging (Delft – Netherlands).

• EMC series:

- 16th European Microscopy Congress (Lyon – France)

For 2017, we will have **two EMS extensions**, the 13th Multinational Congress on Microscopy (24 to 29 September 2017, Rovinj – Croatia) and the Microscopy Conference 2017 (21 to 25 August 2017, Lausanne – Switzerland) plus **five EMS sponsored events**, the SCANDEM 2017 Annual Conference of the Nordic Microscopy Society (Reykjavik – Iceland), Electron Microscopy with High Temporal Resolution EMHTR 2017 (Strasbourg, France), 4th edition of Quantitative Electron Microscopy School QEM2017 (Balaruc les bains, France), 15th International Congress of Histochemistry and Cytochemistry (Antalya – Turkey) and the Advanced Course on Cryo-Electron Tomography (Vienna – Austria). Detailed descriptions and dates can be found on our website.

Furthermore, the EMS again supports young scientists with scholarships to enable them to attend one of the two EMS extensions.

The "Outstanding Paper Award" has been announced earlier this year, and the awardees will be announced in one of the EMS extensions in 2017.

Let me point out that I took over a well sorted EMS when I started with my presidency, and I will work hard to keep it that way. Shortly after the election, the new executive board began its routine, which is strongly due to the work of our secretary, Dr. Virginie Serin, and our supporting organization, MCO. We still receive a lot of input by Nick Schryvers, who helps us with many hints from his time in the board – but we also see a good tendency to get on our own feet soon!

Finally, I would like to express my personal relief about our community's attitude after France has been the victim of several terroristic attacks in 2015 and 2016. Our colleague Dr. Thierry Epicier faced the difficult task to organize a European conference under really difficult conditions. While tourism in France suffered from cancellations, no one could predict how the situation would affect the conference, especially the number of delegates and the willingness of exhibitors to present their exhibits. I am certain that nobody, who attended the Lyon conference, was not shocked by the general situation, but – and this is the good news, after all – we did not notice a drop in numbers. We all, being scientists, assessed the situation, rather than falling prey to panic, and many, many decided to attend the conference – 2500 visitors, to be precise.

We noticed increased alert levels and security measures, but this was a minor trouble for the freedom to assemble and to discuss our scientific matters. It makes me feel a little proud that we all could aid France to conduct its normal life by showing solidarity and by not backing off.

Now, let us look forward to the newly begun year, let us hope for fascinating discoveries and new developments in instrumentation and methods in all fields of microscopy. I wish you all the necessary luck to achieve your personal goals and hope to meet you soon in one of the next conferences, but at latest during the next EMC2020 in Copenhagen! ■

Josef Zweck, President of the EMC

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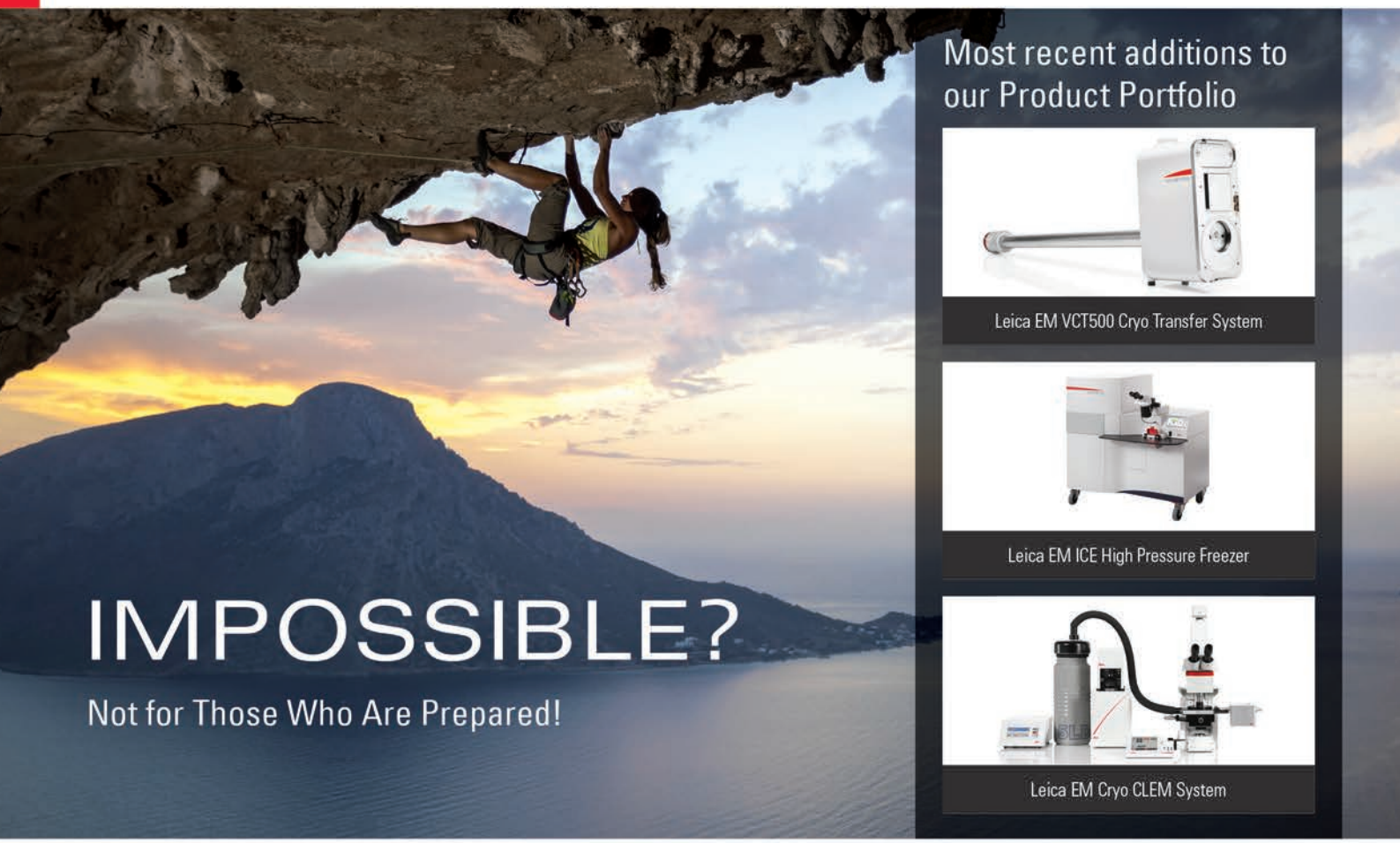

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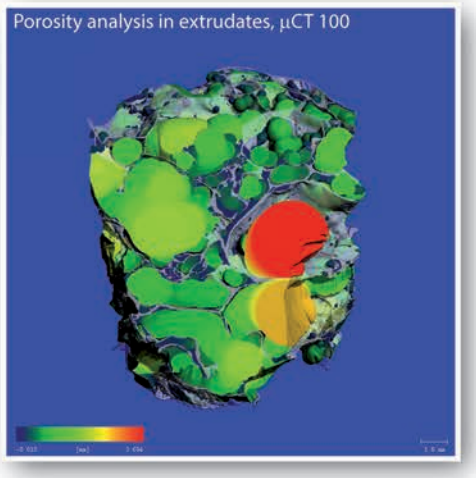

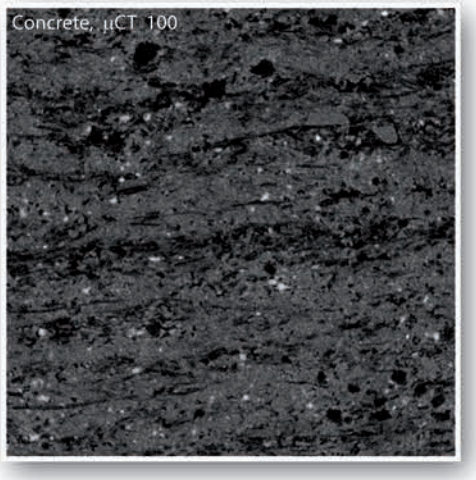

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REPORT ON EMC 2016 & JEOL-EM AWARD LECTURES AT EMC 2016

EMC2016: THE MICROSCOPY EVENT IN 2016

The City of Lyon, a World Heritage Site also known as the City of Lights, hosted the XVIth edition of the European Microscopy Congress, EMC2016, from August 28th to September 2nd last year.

It is indeed tempting to start this short retrospective on the congress with a brief survey of a few messages, extracted from the dozens received after the event, sent by delegates, chairpersons and invited speakers:

> *"Thanks for the wonderful conference! It went really smooth! Thanks to everybody for making this possible"*
>
> *"Just wanted to say how much we enjoyed EMC2016 in Lyon last week – it was a terrific event, in a beautiful city"*
>
> *"I would like to thank and congratulate you once more for your excellent organization"*
>
> *"Thank you for having organized such a wonderful meeting. I am sure that all the participants had an excellent experience and enjoyed it very much"*
>
> *"The ASEM participants have been very happy with EMC2016 which really was one of the best conferences of the last years"*
>
> *"I would like to thank you for your enormous work which resulted in a smoothly going but on the other hand very high-level scientific congress!"*

Is there any better satisfaction for organizers to have reached the goal of offering all participants a fruitful congress? Is there any better satisfaction for all participants to have experienced an exciting conference, rich in vibrant exchanges, discoveries while sharing results and innovations? From all feedback, EMC2016 was the opportunity of great scientific exchanges, great talks and posters or scientific contributions such as round-tables, workshops, demos, exhibitions. It also provided a cultural touch with the reference to the birth of cinema, the amazing *Musée des Confluences* (and its optical microscopes collection), a taste of *Lyonnaise* gastronomy and professional street dancing.

The total number of attendants attests to this success: 2355 participants, among which 1524 delegates (including 377 "Young Scientists" - a quite good ratio) having submitted 1410 abstracts: very high scores in the history of the EMC series indeed.

Outstanding talks were given by our invited plenary speakers, covering a very broad panel of subjects in the major fields of microscopy. Bram Koster (LUMC, Leiden, Netherlands) as an artist in molecular biology proved that we can bridge the gap between electron and light techniques, to navigate in 3D into cellular architectures. Eric Betzig (Janelia Res. Campus, VA USA) led us to a wonderful journey into live cell imaging with a large variety of photonic and fluorescence-based imaging techniques, consistently updated and innovatively renewed. Jo Verbeeck (EMAT, Antwerpen, Belgium), as a true wizard in electron microscopy, showed us how to make the TEM a versatile instrument by playing with beams and phases. Hirofumi Yamada (Kyoto University, Japan) demonstrated how we can gently learn from molecules deposited on surfaces by scanning probe techniques. Nadine Peyrieras (CNRS Gif sur Yvette, France) focused on in vivo multiscale and multimodal observations, quantification and multilevel theoretical modelling of biological processes. Last but not least, Frances Ross (IBM, NY, USA) literally allowed us to dive into liquids, an outstanding ongoing development of transmission electron microscopy for more insights into non condensed matter, nano-objects and biological samples.

The EMC2016 plenary speakers (from left to right and top to bottom): Bram Koster, Eric Betzig, Jo Verbeeck, Hirofumi Yamada, Nadine Peyrieras, Frances Ross.

121 invited speakers (from 21 countries, with 20% French speakers and 26% women) 76 chairpersons (from 19 countries, with 37% French co-chairs and 32% women) have animated 31 sessions during the whole week. Several round-tables, workshops or special sessions have completed the traditional and official EMC2016 program organized around 3 main symposia: Life Sciences, Materials Science, Instrumentation and Techniques.

They have hosted 310 oral contributions selected among 800 submissions! 1410 abstracts were thus submitted by 1524 delegates, (possibly the highest numbers in EMC history!) from 54 countries and genuinely international horizons outside Europe: Africa (14 participants), Asia (167), Australia - where the next International Conference IMC19 will be held in 2018 - (16), North and South America (respectively 64 and 15 participants).

The organization was a joint venture between the French Society of Microscopies (SFμ), support of the conference, and MCO Congress, our PCO partner, under the auspices of the EMS society directly associated with 4 representative members (Paul Midgley, Jo Mayer, José L. Carrascosa and Roger Wepf) in the Scientific Program Committee. The French part in this committee was constituted by two couples of scientific vice-chairs for Life and Materials Sciences (Catherine Venien-Bryan, Béatrice Satiat-Jeunemaître, Odile Stephan and Martin Hytch) around the Vice-President and President of the congress (Pascale Bayle-Guillemaud and Thierry Epicier). An International Scientific Advisory Board was also following the organization, with representatives from all national societies affiliated to the EMS and 4 members of the IFSM executive committee. It is worth pointing out the very important and strategic role of our PCO partner in smoothing all technical details of the organization. This includes in particular the relations with the Congress venue (the Congress Centre of the Cité Internationale of Lyon, a magnificent architectural ensemble designed by Renzo Piano), with its impressing 3000 seats Amphitheater (not really filled despite the very large audience especially during plenaries!) and the management of the technical exhibition.

Welcoming our private partners, constructors and manufacturers in all areas dealing with microscopy (instrument, accessories and software) is an EMC tradition. After the success of EMC2012 in Manchester, EMC2016 in Lyon is proud to have been able to maintain the high quality and high participation of companies in a huge exhibition on 3770 sq. meters with 122 exhibitors in 107 booths. Thanks are due to all exhibitors and sponsors who were real contributors to the success of this conference. Among them, 5 booths were representing the candidates bidding for the next EMC2020. This 'competition' leaves us a 'bittersweet' feeling: on the one hand, what a superb demonstration of the dynamism of our community assembled around the EMS, to have 5 bidders for organizing the next European Microscopy congress! On the other hand, only one winner (Copenhagen!) among 5 beautiful and well defended projects by motivated internationally recognized leaders supported by their national

societies. In parallel to the exhibition, lunch and technical workshops were run daily by industrial experts covering all microscopies.

These scientifically oriented activities were traditionally completed by societies and board meetings, the EMS General Council and General Assembly, the EMS awards ceremony (attributed to Angus Kirkland, Oxford, UK and Niels De Jonge, Saarbrücken, Germany) also including the Outstanding Paper Award ceremony followed by the results of the EMC Micrograph Competition.

Dr. Niels de Jonge (left) receiving the JEOL EM-award for the Life Sciences from Roger Wepf (EMS President, right) and Bruno Achard (representative of JEOL Europe, middle).

Right before the congress opened its doors, five pre-congress workshops were successfully held in Lyon and Grenoble and gathered over 100 participants on cryo and environmental microscopy, quantitative STEM, PCA analysis, crystallographic and phase EM mapping. We thank here the local teams for their investment in organizing these sessions.

Besides all these activities, EMC2016 did launch some new initiatives: thanks to a partnership with 'CM-CIC Investment and Innovation', we organized a startup competition to welcome 4 startups. The EMS looked towards the future by covering important topics in special events like a 'Big Data in Microscopy' session and a discussion on 'Managing Large Microscopy facilities'. EMC2016 organized its own lunch workshop dedicated to European and National networks. Although certainly not exhaustive in the European perimeter, this session allowed a brief presentation of some of the main initiatives in the field of microscopies at the European level, but also in Spain, Sweden, and France. Probably to be considered again and improved for the next editions?

This survey of EMC2016 would not be complete without evoking the gala dinner, organized in La Sucrière, a sumptuous, totally renovated former sugarhouse. On the last evening of the Congress, 800 participants shared a sensational moment with local Gastronomy, Street Dance and Live Music entertainment.

The Pôle Pik Company during the EMC2016 gala dinner

We also have to acknowledge Michael Stringer who offered us the right to use the iconic image of diatoms (the Nikon Small World first prize in 2008!) that symbolized EMC2016 during the 4 years of preparation.

Thanks are also due to all public institutions, academic societies (including the SFμ, the EMS and IFSM) and private sponsors, the support of which allowed this event to take place in the best possible conditions, marvelously helped by a warm sunny weather highlighting the beautiful, historical and cultural city of Lyon.

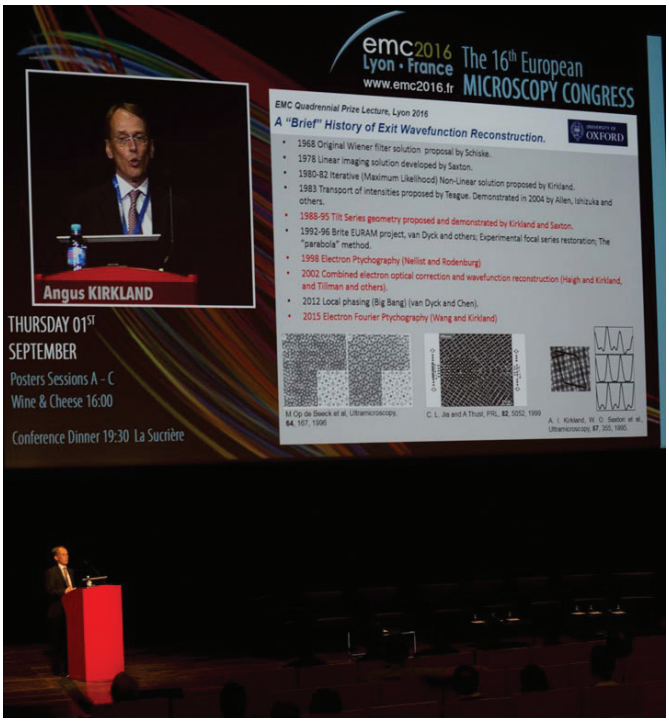
The EMC2016 website (*www.emc2016.fr*) is still active; pictures and links to videos can help you remember EMC2016 and share your souvenirs with colleagues who could not be there. Other useful information is also there, like the abstracts freely accessible owing to the fruitful EMC2016 - Wiley partnership. The 4 Volumes of the Proceedings remain available from the French Society of Microscopies (*www.sfmu.fr*).

Finally, we would like to thank all participants and we hope that we will all meet again in Copenhagen for EMC2020! ■

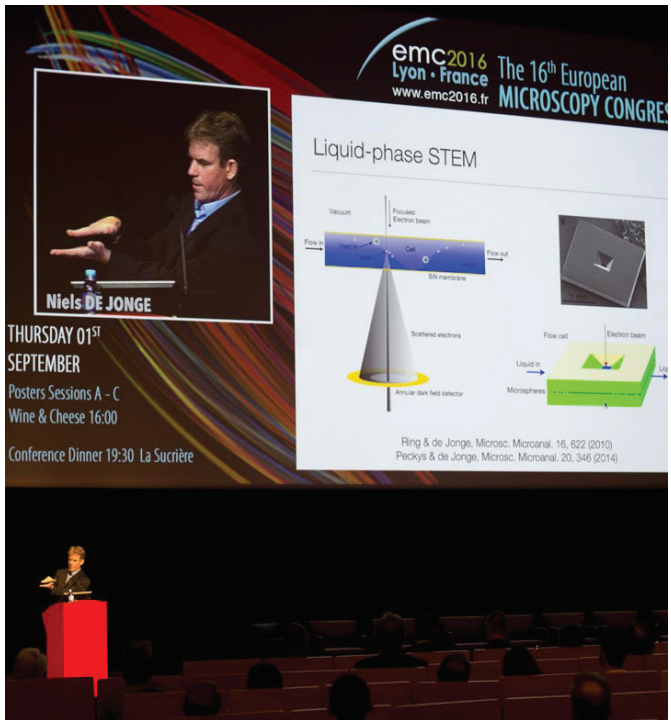
2016 JEOL-EUROPEAN MICROSCOPY AWARDS

The 2016 JEOL - European Microscopy award for the category Physical/Materials Sciences and Optics goes to Dr. Angus Kirkland from the University of Oxford, Department Mat, Oxford, England, for outstanding achievements in theoretical and instrumental areas such as pioneering exit-wave reconstruction, EM ptychography and detector design. The Life Sciences award is made to Dr. Niels de Jonge from the Leibniz Institute for New Materials, Saarbrücken, Germany for outstanding achievements in instrumentation to enable liquid in-situ experiments for the life sciences and nanotechnology. The winners of this prestigious quadrennial award founded in 2004 received the amount of 6.000 euro and a metal-on-wood plaque for display.

We congratulate our winners once more and look forward to a new round in 4 years. ■



JEOL-EM Award lecture Materials Sciences (incl Instrumentation Developments) by Dr. Angus Kirkland



JEOL-EM Award lecture Life Sciences by Dr. Niels de Jonge

SCANNING TRANSMISSION ELECTRON MICROSCOPY OF MEMBRANE PROTEINS IN WHOLE MAMMALIAN CELLS IN LIQUID

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Keywords:
STEM, ESEM, liquid-phase electron microscopy, mammalian cell, nanoparticle, protein label, HER2, breast cancer cell

Introduction

Receptor proteins in the plasma membranes of cells respond to the binding of external ligands triggering distinct signalling pathway/s. But the involved molecular mechanisms are incompletely understood[1, 2]. A key challenge for examining the fundamentals of cell decisions is that these often differ from cell to cell on account of cell heterogeneity, so that even neighbouring cells of the same cell type may show different responses to the same ligand concentrations. Crucial information is lacking about the functional states of membrane proteins within individual cells and about differences between cells[1, 2] as a consequence of the limitations of the used analytical methods[3]. The functional states of proteins are typically reflected in their assembly into protein complexes, the so-called stoichiometry. Protein stoichiometry is generally not examined within intact cells but via biochemical methods involving the extraction of proteins from the cells, via X-ray crystallography of protein crystals or other technologies. Protein material is then pooled from many thousands of cells and thus most knowledge about cellular function is based on population averages. Moreover, extracting the membrane proteins from the plasma membrane may lead to artefacts in conclusions about function, since the actual molecular behaviour of the receptors is not studied in a native environment (Figure 1). On the other hand, state-of-the-art light microscopy techniques using intact cells are incapable of resolving endogenously (naturally) expressed membrane proteins with sufficient spatial resolution[4, 5], so that often opposing observations are published[2]. Cryo electron microscopy can be used to image proteins in an almost native environment of amorphous ice[6] but the sample preparation and microscopy is so elaborative that it is practically impossible to study whole cells let alone series of cells. This paper describes a novel approach for the study of protein function within intact cells. It reflects the contents of the European Microscopy Society Life Science Award 2017 lecture. Part of the text was also published elsewhere [7].

Liquid STEM technology

A new analytical microscopy technology to study membrane proteins in intact eukaryotic cells in their native liquid environment was introduced in the last decade[4, 8-10]. This technology, termed liquid scanning transmission electron microscopy (STEM), overcomes key limitations in the study of cellular function at the molecular level. Eukaryotic cells in liquid are placed in a microfluidic chamber enclosing the sample in the vacuum of the electron microscope, and they are then imaged with STEM (Figure 2A). In order to obtain contrast through water and cell material of several micrometres thickness, gold nanoparticles or fluorescent quantum dots (QDs) are used as specific protein labels[11-13] and the atomic number (Z) contrast of STEM is employed so that nanometre resolution is obtained on tagged proteins in whole eukaryotic cells in liquid[8]. The high resolution is achieved well within the limit of radiation damage[8, 14]. Crucial for the study of cell function is the capability to screen hundreds of cells and to investigate selected tens of cells with high spatial resolution in the range of 3 nm, this was achieved by combining fluorescence microscopy with liquid STEM and correlating the obtained information[11, 15]. It is not always necessary to enclose the cells in a microfluidic chamber. For many studies, it is sufficient to obtain information from the thin outer regions of the cells, and those can be imaged with high resolution using environmental scanning electron microscopy (ESEM) with STEM detector (see Figure 2B)[16, 17]. A third option is given by enwrapping the cells with a graphene sheet[18, 19].

Studying HER2 in intact breast cancer cells

Liquid STEM was used to collect data on receptor membrane expression and stoichiometry of HER2 proteins in cancer cells. HER2 is a member of the epidermal growth factor family of receptors. This family of membrane proteins regulates cell proliferation, survival and various other processes. Under physiological circumstances, most HER-family members are activated by ligands and dimerize with another activated HER protein. The activated dimer protein

complex then triggers intracellular processes. This situation is different for the family member HER2, an orphan receptor that does not have a known ligand. It resides in the plasma membrane in an open conformation ready to form homodimers or heterodimers with other members of the HER receptor family. As a consequence, intracellular signaling and cell growth is frequently dysregulated in HER2 overexpressing cells[20]. HER2 is overexpressed in a particularly dangerous type of breast cancer, as well as in other cancer types[21].

SKBR3 cells, a HER2 overexpressing human breast cancer cell line, were studied with correlative fluorescence microscopy and liquid ESEM-STEM (Figure 2B). In order to visualize the locations of individual HER2 proteins, a specific label was developed for HER2 using an Affibody peptide with a biotinylated C-terminus[22] (Affibody AB, Sweden) conjugated to a QD via a short biotin-streptavidin bond to a QD[4]. In contrast to conventional electron microscopy studies, the cells were imaged as a whole and in liquid state, so that the membrane proteins remained in the intact plasma membrane[4]. Fluorescence microscopy revealed considerable differences of HER2 membrane expression between individual cells, and between different membrane regions of the same cell (Figure 3A-B). Subsequent ESEM of the corresponding cellular regions provided images of individually labelled HER2 receptors (Figure 3C-D). The high spatial resolution of 3 nm, the 1:1 labelling stoichiometry, and the close proximity between the QD and the receptor allowed quantification of the stoichiometry of HER2 complexes. It was also possible to distinguish between monomers, dimers and higher order clusters.

The clustering behaviour of HER2 was statistically analysed via the pair correlation function g(r) [23], calculated from all individual HER2 positions. The function g(r) measures the likelihood of a particle to be found within a certain radial distance with respect to a reference particle, whereby g(r) = 1 represents a random distribution, and a value >1 indicates clustering with a higher probability than random occurrence[23]. In measurements incorporating 14,043 HER2 positions in eleven cells, a sharp peak in the g(r) function at 20 nm indicated that HER2 was clustered as a homodimer (Figure 4A). A centre-to-centre label distance of 20 nm was expected on account of the size of the HER2 dimer, and the two quantum dot labels[4].

HER2 distribution patterns were determined for two distinct cellular regions: membrane ruffles and homogeneous or flat areas. A remarkable difference was found from analysing g(r) for these different membrane regions. HER2 homodimers (peak at g(r) = 20 nm) appeared in ruffled regions but were entirely absent from homogeneous membrane regions (Figure 4B). In cancer cells, the highly dynamic membrane ruffles, also referred to as *invadopodia*, are considered to serve as junctions for cellular signalling, and drive motility, invasiveness, and metastasis of cancer cells[24]. The results could thus imply that HER2 homodimers play a role in cancer cell spreading.

A second imperative finding was the discovery of a small subpopulation of cells with a different phenotype than the average cell[4]. This group of cells was characterised by flat peripheral membrane regions and can possibly be identified as resting (possibly dormant) cells. HER2 homodimers were found to be absent from this subpopulation of cells (Figure 4C), even though the concentration of HER2 in the plasma membrane was only ~ 30% lower than in the bulk cancer cells. The absence of HER2 homodimers from these flat cells likely indicates a different intercellular signalling mechanism than the average/bulk SKBR3 cell.

Conclusions

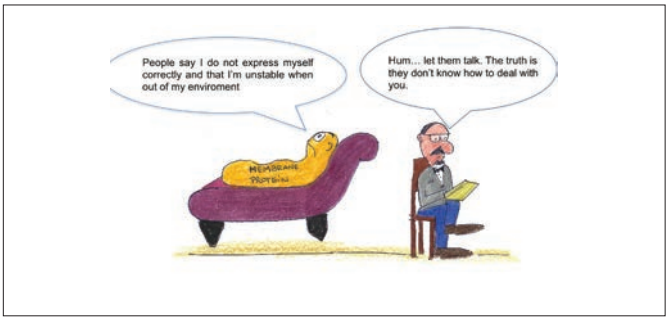
Liquid STEM combined with correlative fluorescence microscopy enables the analysis of the functional (stoichiometric) state of membrane proteins at the molecular level in single cells and can account for heterogenic cell populations by examining tens to hundreds of individual cells. A spatial resolution of 3 nm is achievable on labelled proteins in whole cells and within the limit of radiation damage. The signalling inactive/active states of HER2 proteins in breast cancer cells were studied at the single molecular and single cell level revealing significant differences between individual cells and cellular sub-regions. These findings are possibly relevant for understanding the origins of drug resistance development.

Acknowledgements

The author is grateful to D.B. Peckys for co-pioneering liquid STEM and for many discussions, M. Fritz for providing Figure 1, and E. Arzt for his support through INM.

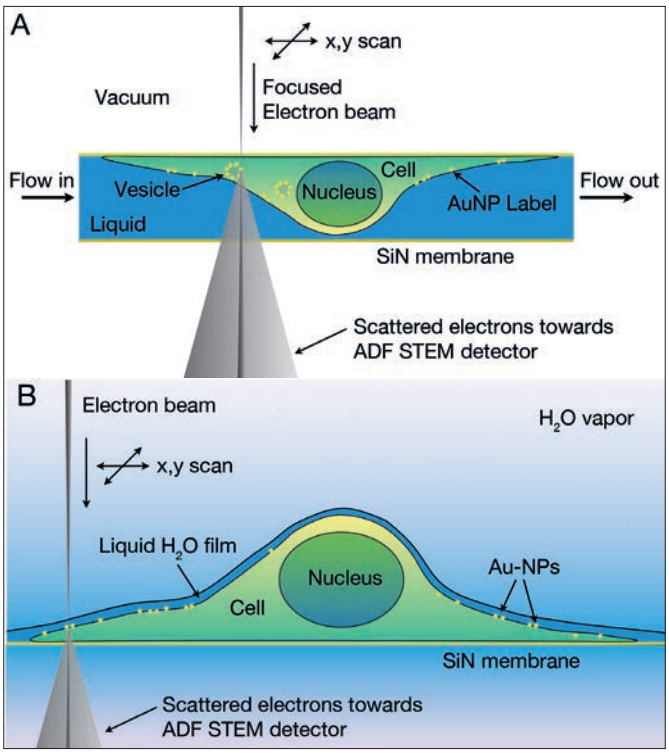
Figure Captions

Figure 1.



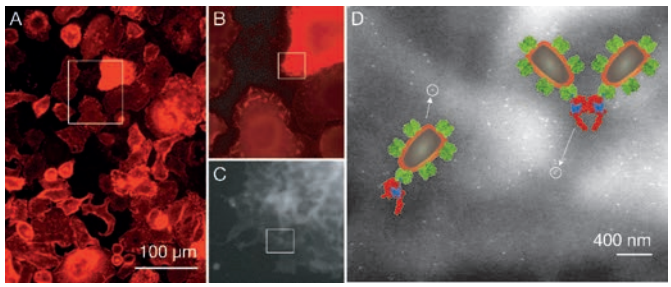
Membrane proteins when extracted from the plasma membrane of a cell may not necessarily resemble the native functional state. Conclusions about their function drawn based on biochemical - and crystallographic techniques using extracted protein material may contain artefacts. Image courtesy of Macarena Fritz K., https://www.linkedin.com/pulse/insane-membrane-how-overcome-problems-when-working-proteins-fritz

Figure 2.



Principles of liquid scanning transmission electron microscopy (STEM). A whole cell is grown on a supporting silicon nitride (SiN) membrane. Proteins labelled with nanoparticles (NPs) reside in the plasma membrane. Imaging is done by scanning a focused electron beam over the cell. Transmitted electrons are recorded with the STEM detector located underneath the sample. (A) The cell is fully enclosed in a microfluidic chamber with two SiN windows. (B) The cell is maintained in a saturated water vapour atmosphere, while a thin layer of cooled water covers the cell for STEM using environmental scanning electron microscopy (ESEM). With permission from Cambridge University Press [10].

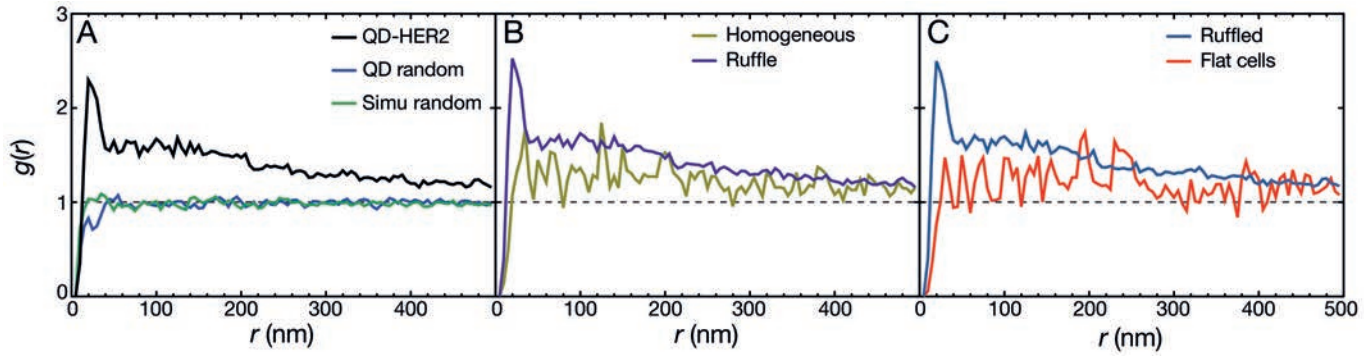
Figure 3.



Correlative light and electron microscopy overview images of QD labelled HER2 on SKBR3 human breast cancer cells[4]. (A): Fluorescence overview image showing several dozens of cells. Individual cells exhibit a high degree of heterogeneity in their morphology and HER2 membrane expression. (B): Fluorescence image of the cells within the boxed area in A. (C): Liquid STEM image of the boxed region in B recorded at 15,000 × magnification using ESEM. (D): STEM image recorded in the boxed region shown in C at 75,000 × magnification.

The locations of individual HER2 receptors labelled with QDs are visible as the bright spots. The brighter background features represent membrane ruffles. Many pairs (homodimers) are visible. Note that the image looks very different to conventional electron microscopy images showing the cellular ultrastructure. The left overlay shows a model of a HER2 homodimer with attached label the biotinylated anti-HER2 Affibody (blue) binding to a single epitope of HER2 (red). The single biotin moiety of the Affibody binds to streptavidin (green) conjugated to a bullet-shaped quantum dot (QD). The right overlay reflects a HER2 homodimer with two attached labels.

Figure 4.



Statistical analysis of the spatial distribution of labelled HER2 proteins in eleven SKBR3 cells using the pair correlation function g(r) [4]. (A) g(r) calculated for a total of 14,171 labels exhibited a peak at 20 nm indicating HER2 dimerization. Larger-sized clusters were also observed. The curves of randomly dispersed quantum dots (QDs), and a simulation (simu) of random data were included as reference. (B) HER2 pairs were absent in cellular areas with homogeneous or flat membrane topography (3,307 labels), contrasting g(r) in the ruffled areas. (C) HER2 does not appear clustered in the two analysed flat cells (3,664 labels). Clustering was only observed in cells with membrane ruffles. ■

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A BRIEF HISTORY OF EXIT WAVEFUNCTION RECONSTRUCTION

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This short article is offered as part of my award of the 2017 Quadrennial Prize from the European Microscopy Society reflects on developments in exit wavefunction reconstruction in the transmission electron microscope and highlights some of the history of my involvement in this field.

Colloidal Metals and a PhD

I completed my PhD, in Cambridge in the last century (in 1989 to be precise) working on the structures of colloidal metal particles under the supervision of Professor Peter Edwards FRS. The aim of this was to critically compare the structures of small particles of different metals at different sizes and to try to understand why certain morphologies are preferred. Ultimately, the long term aim was to relate these to catalysis but as with many PhD projects curiosity driven research took over and the project drifted from these long term goals; of course with the support of my supervisor.

During my PhD work I was however able to identify two new structures.

Firstly, the tendency of Cu to form multiple parallel twins at small particle sizes [1] (Figure 1) in contrast to Ag and Au, in the same group of the periodic table, which form predominantly multiply twinned (decahedral and icosahedral) geometries as originally studied by Howie, Marks and Smith. The reasons for this are complex but can be explained by the interplay between strain and twin boundary energies.

Secondly, I was able to identify that Ag and Au particles formed under conditions where kinetics dominate the growth process form "trigons" [2]. Interestingly high resolution phase contrast images of these show fringe spacings that are formally forbidden for fcc metals. To explain this, I carried out multislice simulations (on an IBM mainframe) which demonstrated that these arise from the presence of parallel {111} twins normal to the beam direction. To experimentally verify this, I was able to image these particles in a 90° orientation. With modern high tilt specimen stages this would be easy but then it required aggregating the colloid and hunting for suitably oriented particles to record

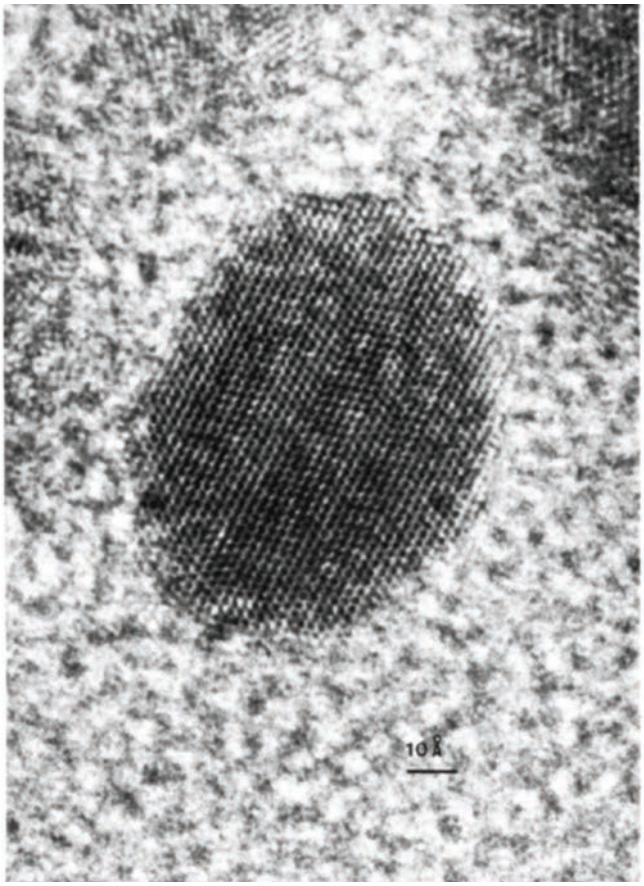

Figure 1. *Particle of copper showing five parallel {111} twin planes all passing completely across the crystal. The electron beam is parallel to a <110> direction. Reproduced from Reference [1].*

images on film. Interestingly, this particle morphology for Ag has recently become popular due to its interesting plasmonic modes which have been mapped using EELS by several groups.

During these experimental investigations it became clear that with TEM resolutions available it would be difficult to intuitively identify the morphology of particles away from high symmetry zone axes. I therefore built (and simulated) a "matrix" of images of various particle morphologies as a function of tilt supported on a model for amorphous carbon [3]. Each matrix required several hours of CPU time on the IBM 3084 mainframe in Cambridge (corresponding to several days of "real time") to compute before the images were ready to be printed on a thermal printer to produce grey scale representations. However, I was able to assign experimental images that were otherwise uninterpretable to specific morphologies by qualitative visual inspection (Figure 2). However, it was clear that any further progress would require higher resolution and more quantitative matching of experiment and simulation.

Post Docs, Fellowships and early Exit Wavefunction Reconstructions

Having finished my PhD I moved to a post-doctoral position in the Department of Materials in Cambridge (located in the Old Cavendish laboratories) to take responsibility for a new JEOL JEM 4000; this immediately doubled with the arrival of Colin Humphreys from Liverpool who had also purchased a JEOL JEM 4000 that he brought with him! One of my main tasks was to install a new objective lens polepiece (a condenser objective geometry designed by Katsushige Tsuno) into the first instrument. At that time post docs routinely dismantled and reassembled microscopes and this gave me my first exposure to the practical side of electron optics.

With the arrival of these new instruments equipped with digital control the quest for improved resolution could be resumed. At this time, I was fortunate to meet Owen Saxton with whom I subsequently enjoyed a very exciting and profitable collaboration spanning some nine years. Owen persuaded me that it was worth attempting to extend resolution using aperture synthesis and the new instruments seemed to provide an ideal platform. However, although we recorded data the restorations were hampered by inaccuracies in the measurement of the aberrations. I had been funded by the Royal Society to visit Japan and as part a month long stay was able to visit JEOL to attempt tilt series restoration using a very early 200kV FEG TEM. Working with Masa Kawasaki we recorded over 100 datasets (each containing two axial and 4 tilted illumination images) on film with the microscope controlled through an RS232 interface. It was clear that the improved coherence of the FEG led to much clearer diffractograms offering some hope that we would be able to measure the aberrations with sufficient accuracy. However, focal drift was still an issue in a noisy factory environment and I became nocturnal for a week in attempt to record suitable datasets. On returning to Cambridge Owen and I analysed the best of this data and were able to demonstrate an improvement in the reconstructed resolution to better than 1.4A compared to the axial limit of 2.3A. (Figure 2) Clearly super resolution was feasible [4]. It is worth noting that at the same time John Rodenburg was working on ptychographic reconstruction schemes (with Peter Nellist) and it was clear to both groups that for certain defined conditions these were reciprocal to the tilt series approach.

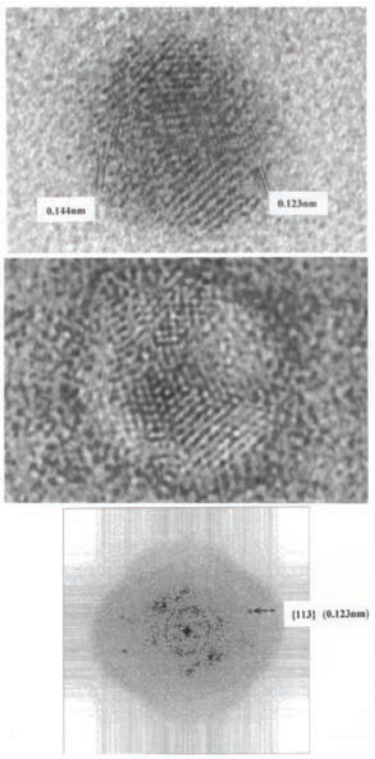

Figure 2. *The restoration. Top and Centre: the restored particle in modulus and phase form with 0.14 and 0.12nm fringes marked.; the field is 10nm wide. Bottom: the spectrum (as log transform intensity) of the restoration, showing extended transfer free of transfer function oscillations. Reproduced from Reference [4].*

The problem of aberration measurement was still limiting and a PhD student from Hannes Lichte's group joined us to work on this problem. Hannes and Dirk van Dyck had secured a large European grant to develop holography and focal series reconstructions (the BRITE EURAM project) and in a collaboration Ruedi Meyer was set the challenge of developing a method that could be fully automated and which would work on crystalline samples. Ruedi came from a mathematical background and provide fresh insight into this problem He successfully developed a two stage method which was more accurate, could be fully automated and worked well for crystalline materials [5] thus opening up wider potential applications for super resolved reconstruction. An early example of the use of this was in the reconstruction of encapsulated crystal in carbon nanotubes (Figure 3)[6] which formed part of a successful collaboration with Malcolm Green and Jeremy Sloan at Oxford.

Ruedi also worked on characterising the CCD cameras now used to record the experimental data and developed a comprehensive model describing the electron and photon scattering in indirectly coupled CCDs [7] which enabled us to deconvolve the blurring introduced by the detector chain. Much later this led to a program of direct detector development.

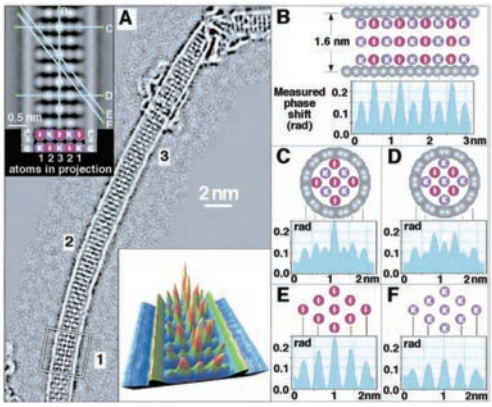

Figure 3. *(A) Phase image showing a ,110. projection of KI incorporated within a 1.6-nm-diameter SWNT, reconstructed from a focal series of 20 images. Maximum and minimum spatial frequencies of 1/(0.23 nm) and 1/(1.05 nm), respectively, have been retained with a Wiener filter. The upper left inset shows an enlargement of region 1 (symmetrized about the chain axis) and a schematic illustration depicting alternating arrangement of I-2-3I-2K-I and K-2I-3K-2I-K {100} layers within the crystal. The lower right inset shows the surface plot of region 1. (B to F) Single-pixel line profiles obtained from line traces marked B to F in the upper left inset in (A). The background level in these profiles is arbitrary because the reconstruction procedure does not recover low-spatial-frequency variations in phase. Schematic crystal structures showing atoms contributing to the contrast are also shown. Reproduced from Reference [6].*

Oxford and Aberration Correction

In 2003 the late David Cockayne persuaded me to move to Oxford where the first double aberration corrected instrument (the OJ)* was being installed. My first Oxford DPhil student (Sarah Haigh) was given the task of extending super resolution into the aberration corrected era. It was clear that the elimination of axial coma and C3 opened up the possibilities of using larger tilt angles in the data acquisition, potentially further improving resolution. Sarah successfully recorded a high angle data set and was able to resolve the 78pm spacing in Si <112> exceeding the axial limit of 115pm[8]. Sarah also explored other resolution limiting factors and demonstrated that ultimately sample thickness rather than optical effects would be limiting. In parallel, during this period Shery Chang worked on using focal series restoration to quantify surface structures in metal nanoparticles[9] from measurements of the reconstructed phase and Christian Dwyer together with Peter Hartel from CEOS utilised the upper corrector in an unusual mode to form "small pencil" for future diffractive imaging and ptychographic experiments[10].

Finally, Peter Nellist and I were able to establish a basic confocal geometry using both aberration correctors[11], a method which was subsequently extended by Peter's group and in particular by Peng Wang.

* In this context OJ refers to the Oxford-JEOL microscope rather than to a citrus drink

Acknowledgments

I have already mentioned some of my mentors and colleagues in the text. I also want to acknowledge and thank a number of very talented scientists who have worked in my research group over the last 25 years and who have carried out much of the work described. Their contributions have inspired me and continue to make all the difference to our progress. Finally, I would like to thank those who were kind enough to nominate me for the EMS prize; by tradition you remain anonymous by you have my gratitude. ■

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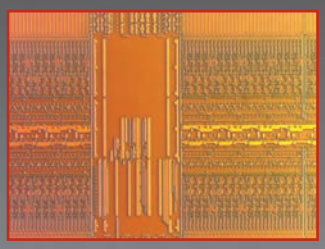

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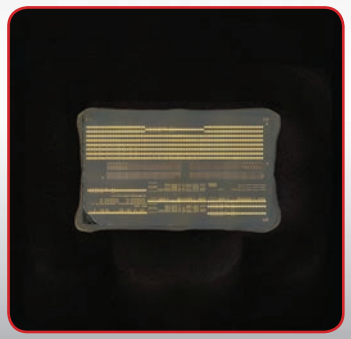

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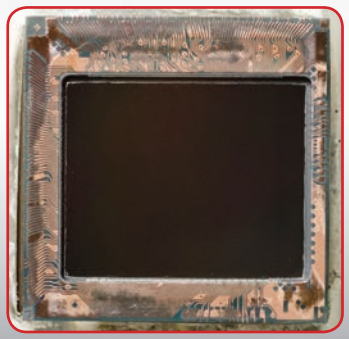

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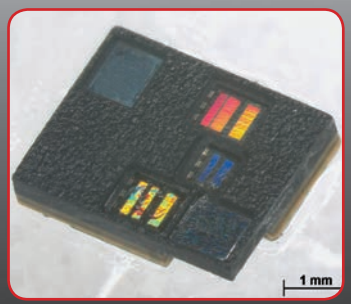
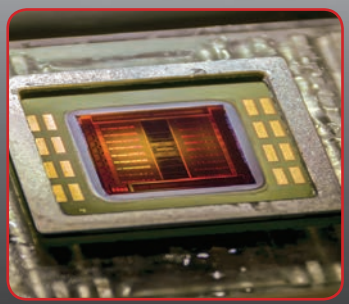


Open areas as small as 100 x 100 µm



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REPORTS ON EMS SPONSORED EVENTS

EMS SPONSORED EVENTS IN 2016

- **4th Quantitative Bioimaging 2016**
  January 13 – 15, 2016
  Delft University of Technology
  Delft – Netherlands

- **International School on Fundamental Crystallography with applications to Electron Crystallography**
  June 27 – July 02, 2016
  Groenenborger Campus / University of Antwerp
  Antwerp – Belgium

- **Conference on In-Situ and Correlative Electron Microscopy - CISCEM 2016**
  October 11 – 12, 2016
  Saarbrücken – Germany

EMS PATRONAGED EVENTS

- **5th Stanislaw Gorczyca European School on Electron Microscopy and Electron Tomography**
  July 5 – 8 July, 2016
  AGH University of Science and Technology
  Krakow – Poland

4TH QUANTITATIVE BIOIMAGING CONFERENCE

Delft, The Netherlands, January 13-15, 2016

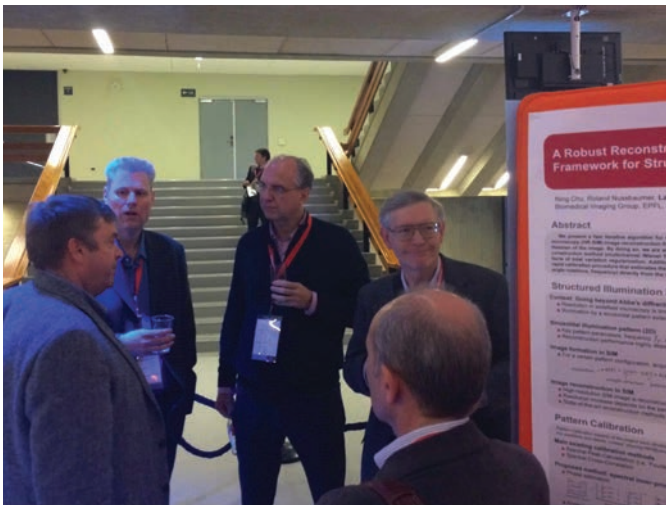
The conference attracted 190 participants from all over the world to the Aula of the TU Delft. Also this year, the spirit of the conference was followed by the recognition that there is a need to address, in a focused and interdisciplinary manner, the analysis of bioimaging data.

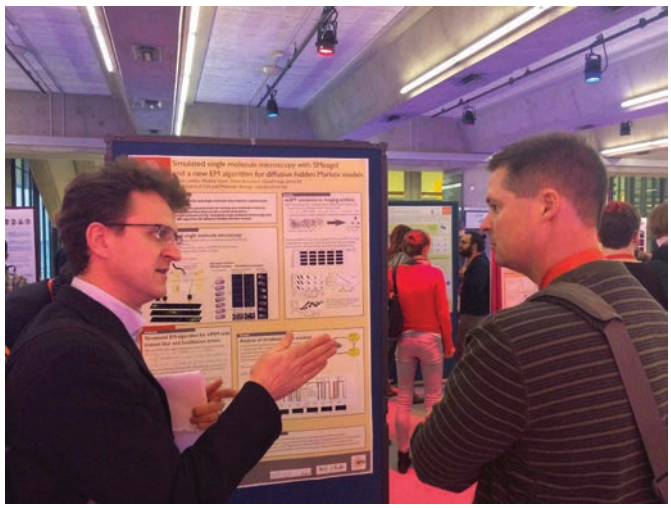
The meeting was centered on discussion and exchange in the lobby of the Aula. Around 70 posters were displayed for two days. Following the two 1h poster sessions, lively exchange took place during coffee, lunch and the reception on Wednesday evening. In the lobby, we had four booths from Zeiss, Lambert Instruments, Hamamatsu and Delmic.

The first keynote lecture, from W.E. Moerner, attracted special attention and there were substantial discussions on optimal ways to use Point-Spread-Function engineering techniques for 3D super-resolution fluorescence imaging. On Wednesday afternoon, we featured "pair-talks" in which a biological and technical researcher talked about their collaborative project from two different points of view. This innovation was very well received and we plan to keep this to strengthen the interdisciplinary character of the meeting.

Two students (from Boston, USA and Wageningen, NL) received a poster price based on their elegant explanation of the poster to members of the jury. They were given a 30 minutes speaking slot at the next QBI conference 2017, which will be held in A&T University, Texas, USA. ■

Prof. Dr. Niels de Jonge





INTERNATIONAL SCHOOL ON FUNDAMENTAL CRYSTALLOGRAPHY WITH APPLICATIONS TO ELECTRON CRYSTALLOGRAPHY

University of Antwerp, Antwerp, Belgium, June 27 - July 02, 2016.

The school started with an optional day on matrix crystallography, as a necessary background, followed by two lecture days on Fundamental crystallography, given by a tandem of two excellent lecturers Massimo Nespolo and Mois Aroyo, past and current president of the IUCR commission on Theoretical and Mathematical Crystallography. The lectures included such topics as crystallographic symmetry in general, point groups, space groups, group-subgroup relations and the reciprocal lattice. These lectures consisted of short theoretical explanations alternated with exercises. After this, there were three full days on electron crystallography, given by Joke Hadermann, focussing on the different electron diffraction techniques and the different types of crystallographic information that could be obtained from those. These lectures consisted of larger blocks of theory, alternated with large exercises in which the students were asked to participate in the step-by-step solution through an immediate individual response system. A poster session was organised, in which 17 students participated, showing posters on their own TEM work or on their crystallographic background. All students that presented a poster and attended the whole school were presented with a book at the end of the school ("Electron Crystallography", by Zou, Hovmoller and Oleynikov). The students had an opportunity to obtain 3 ECTS (European Credit Transfer System) for the completion of the school, by passing an online exam after the school.

The school had 38 participants from 21 nations, of which 30 were under the age of 30. Thanks to grants provided by the scientific organisations IUCr and ECA, and redistribution of part of the income from registration fees, 10 young students (3 India, 2 Russia, 1 Czech Rep., 1 Poland, 2 Brazil, 1 Austria) could be provided with scholarships covering all of their travel and/or subsistence costs. For helping with the organisation costs of the school, we are grateful to the scientific organisation EMS and to the companies Nanomegas, FEI and Calidris. The school was supported by the IUCr Commission on Theoretical and Mathematical Crystallography and by the Special Interest Group on Electron Crystallography from the ECA. Material and organisational support was also provided by the University of Antwerp and in specific the Antwerp Summer University. ■

Prof. Joke Hadermann

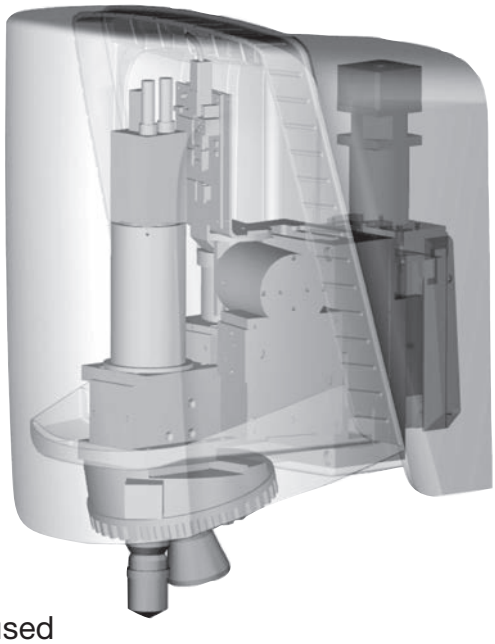
3RD CONFERENCE ON IN SITU AND CORRELATIVE ELECTRON MICROSCOPY (CISCEM)

11 - 12 October 2016, Saarbrücken, Germany.

The INM - Leibniz Institute for New Materials, Saarbrücken, Germany, hosted the 3rd Conference on *In Situ* and Correlative Electron Microscopy (CISCEM), October 11-12, 2016. The conference with about 80 participants brought together an interdisciplinary group of scientists from the fields of biology, materials science, geology, chemistry, and physics, to discuss future directions of in situ electron microscopy from different "viewing angles". Highlight was the keynote lecture of Prof. Frances M. Ross, IBM, Yorktown Heights, NY, USA, who spoke about liquid-cell transmission electron microscopy for imaging electrochemical processes. The topics of the oral and poster presentations included nanoscale studies of biological samples, and functional materials under realistic or near realistic conditions, for example, in gaseous environments, at elevated temperatures, and in liquid. It was shown how dynamical processes are studied by including the time domain in electron microscopy, while taking into account the electron beam effects. The wide variety of materials and dynamical phenomena investigated demonstrated the rapidly growing interest of the international scientific community in characterization at the nanometer length scale using in situ approaches, transforming electron microscopes from merely imaging devices into multi-parameter experimental platforms. The extended abstracts will be published online as supplementary section of the journal Microscopy and Microanalysis. ■

Niels de Jonge

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.

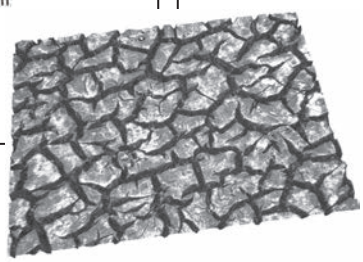
The most common optical measurement technologies used today for the three dimensional measurement of technical surfaces are Confocal, Interferometry and Focus Variation.

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 the measurement of those regions where the slopes are high (up to 86°), highest measurement speeds (mm/s) and where the surface is very rough, while confocal technique will provide better results for smoother and flatter surface regions.

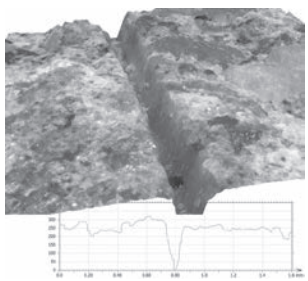
This combination of measurement capabilities is mainly used for tooling applications and textured surfaces.

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.

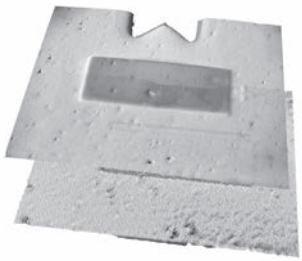
3D view of leather



3D view of laser marks & profiles



Representation of thin film thickness measurement



MICROSCOPES IN THE 18TH CENTURY, HENK KUBBINGA

MICROSCOPES IN THE 18TH CENTURY

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EPS-History of Physics Group
Int. Academy of History of Science, University of Groningen
Email: h.kubbinga@home.nl

In a foregoing paper, in EMS Yearbook 2015, I described the first microscopes, from Drebbel's and Hooke's compound systems to the single lenses of Descartes and Leeuwenhoek. Until his death in 1723 Leeuwenhoek dominated microscopy. Less powerful instruments, commercially brought on the market, allowed laypeople and academics to step in. Gradually, accessory equipment was developed. We will see how the solution of chromatic aberration implied a breakthrough. An essential reference should have been mentioned earlier here: Dieter Gerlach's monumental *Geschichte der Mikroskopie* (Verlag Harri Deutsch, 2009).

Microscopy as such

From about 1700 onwards microscopy as a hobby spread among the nature-minded up-perten, more and more organized in societies aiming at educating the citizenry. Hooke's adagium that mankind's sense-organs, more particularly the eyes, had deteriorated since the Fall of Adam & Eve and now needed some support by 'artificial organs' to achieve the same as in the Garden of Eden, was generally accepted. The faithful, then, retraced God's wisdom in the 'technical' perfection of the tiniest creatures; theology-through-microscopy, so to speak, better known as 'natural theology'. The first textbooks on microscopy appeared on the market. An interesting case in point, from the technical point of view, is Louis Joblot's monograph *Descriptions et usages de plusieurs nouveaux microscopes* [..] (1718) (Figure 1), which also details new observations. On the other hand, more down-to-earth craftsmen profiled themselves as sound business-as-usual entrepreneurs, producing ever more sophisticated and, naturally, ever more expensive instruments. Microscopy as a science flourished nonetheless, since the same entrepreneurs-craftsmen discovered the universities as markets in their own right, where the new 'experimental philosophy' required all kinds of instruments. Even the astronomers came under the spell of that alternative passtime: the frenchman Lacaille, on expedition in Africa (1750-1752), called one of the newly identified constellations in the southern hemisphere *Microscopium*.

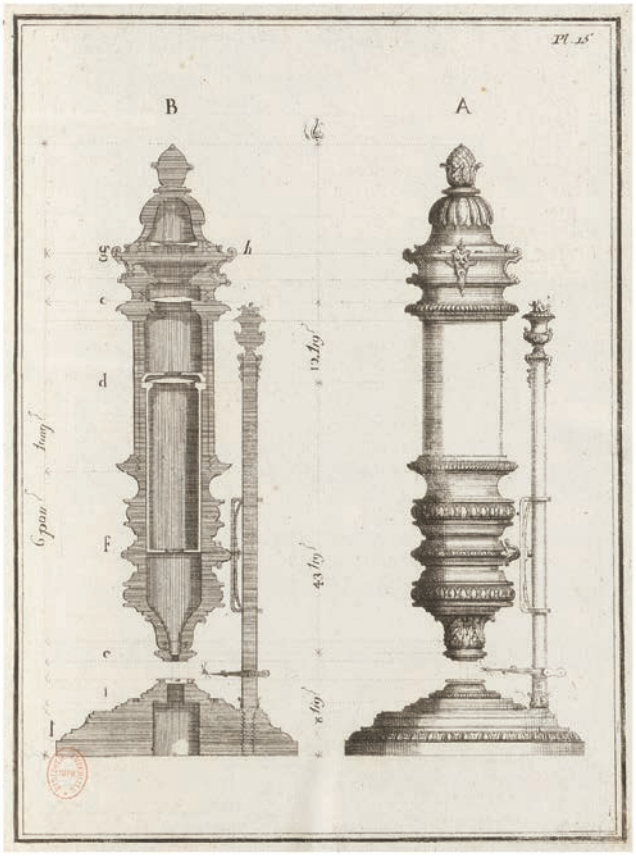

Figure 1: *Compound microscope discussed in Joblot's monograph Descriptions [..](1718). Height: 6 'pouces' or 162,4 mm. The three biconcave lenses (objective, field-lens, ocular) are in fixed positions. The two-stage dust-cap on top hides a biconcave lens, the use of which is unclear; perhaps for a Galileo-type arrangement, when put in place of the biconvex ocular ? The three biconcave lenses produce a magnified real image. Do notice the pillar and the systematic use of stops to reduce spherical aberration. A hole in the base allows for observations in transmitted light. The precision of the drawing together with the indicated scale (1 pouce = 27,07 mm; 1 ligne = 2,256 mm) allows for some calculations. If the height of the insect indicates the focal distance of the objective, we read out: $f_{objective}$ = (3 lignes =) 6,8 mm; $f_{field\text{-}lens}$ = 90,2 mm; eye-distance from ocular 54,1 mm. What about the magnification? Courtesy: Bibliothèque Nationale de France, Paris.*

Technical innovations; simple vs. compound

Well aware of the limitations of dioptrics, the great proponent of the new approach, Isaac Newton, weighted the possibilities of mirror microscopes, but did not insist (1704). All kinds of single-lens systems were produced to amuse the happy few, but their magnifying power could not stand comparison with those of Leeuwenhoek's glasses. And Leeuwenhoek, the secretive, lived on and on and on ... His contrivance was adapted by those lucky enough to have been in his company. So the 'compass microscope' came in, often

equipped with a mirror around the lens to get more light on the specimen (van Musschenbroek, Lieberkühn,..); the mirror was mostly called after Lieberkühn, though for instance, Descartes was already familiar with it. The 'circle microscope' was a variant. On the other hand, the 'flee-glass' was transformed into a powerful 'screw-barrel microscope' (Hartsoeker, Wilson, Culpeper, ..) or provided with a ball-and-sockets arm on a base (Joblot, Lyonet), e.g. to study fresh water polyps. The grounding of elliptical, parabolical and hyperbolical lenses appeared finally feasible, as the German glass-specia- list Christian Gottlieb Hertel (1683-1743) publicly announced in 1727; earlier Hertel had introduced the concave mirror to focus light on transparent preparations. All the time chromatism stayed on as troublemaker, though some people realized that the structure of the supposedly achromatic human eye might suggest a solution.

Among the first to make use of the concave mirror was Edmund Culpeper (ca. 1670-1738). His version of a Hooke type instrument featured a two-stage tripod on a base, with in-between the object table and, below, the substage mirror. The base, then, was soon provided with a drawer to keep accessories (i.e. various objectives) (Figure 2). It was produced by many opticians well until the end of the 18th century. However, as a research tool it was somewhat impractical. The handling of the objects to be studied between the legs appeared to be cumbersome indeed, while the fine-focusing of the eye-piece was hard because of the shockwise gliding of pasteboard on pasteboard. When

Figure 2 : *Culpeper microscope (ca.1730). The eyepiece (ocular plus field-lens) may be shifted in the mainbody depending on the particular objective used. Do notice the extra lens at the object table and the sub-stage spherical (!) mirror. In the present state it is ready to be used for the study of slide-sticks, samples between muscovy-glass in ivory holders. Courtesy: Whipple Museum, Cambridge.*

Figure 3 : *Cuff microscope (ca.1745). The cross-like object table features a 'Lieberkühn'-mirror for extra on-top illumination and two slots, the one for a condenser lens, the other for objects e.g. on top of a needle. The mainbody is fixed to a compound pillar, allowing for crude and fine tuning. Courtesy: Whipple Museum, Cambridge.*

brought to the attention of John Cuff (1708-1772), London, these problems were rapidly solved (1744).

Hooke's self-lubricating lignum vitae (guyacum wood) and the pasteboard of the tube were exchanged for elegant, sometimes gilded brass, which allowed for stable and more swiftly manipulable constructions. The body tube including the ocular-and-field-lens carrying drawer was connected to a stick sliding along a fixed pillar for the coarse focusing, a finely threaded stick-plus-bolt being available for the fine-tuning (Figure 3). Do notice in Figure 2 the presence of an extra single-lens directed at the object table; the cross-like object-table in Figure 3 features two slots, in which a single-lens on a fork (or other equipment) and a sample-carrying pin could be positioned. The 6 objectives of focal distances from 25 to 2,3 mm allowed for magnifications from ×23 up to ×270.

Figure 4 : *Cut-out from an engraving by François Antoine Aveline. We see Daubenton using a Cuff-type microscope to study a preparation. Two candles serve as light-source, a gilded(?) Chinese draught-screen as a primary mirror. Source: Buffon, Histoire naturelle [..], volume II (1749), p.1. Courtesy: Bibliothèque Nationale de France, Paris.*

Figure 4 shows a practicing microscopist with a Cuff-type instrument, about 1747, in Paris: it concerns Louis Jean-Marie Daubenton, the right-hand of the french naturalist Buffon. The engraving has given rise to much misunderstanding, since a thorough facts' check showed that the observations reported by Buffon in the account following the engraving demanded a far stronger magnifying instrument: a Cuff-microscope magnified at best ×270, as we just saw, where about ×400-500 was at issue. In the 1980s, Phillip Sloan (University of Notre Dames, IN) revealed that the numerical data provided by Buffon himself in a paper published, separately, in the *Mémoires of the Academy* (Table 1) referred to a scroll-mounted screw-barrel microscope, as described by Henry Baker, in his well-known manual *The microscope made easy [...]* (Figure 4). One of the lenses involved even outdid the strongest glasses of Leeuwenhoek ! Buffon had been criticized i.a. by the Italian

Figure 5 : *The scroll-mounted screw-barrel microscope according to Henry Baker. From the Dutch translation (1744) of his work The microscope made easy [..] Courtesy: University Library Groningen.*

Lazzaro Spallanzani: well aware of the low power of the Cuff-microscope – that is: compared to Leeuwenhoek's single lenses – Spallanzani had ridiculed Buffon's claims. The Frenchmen could impossibly have observed the animalcules in semen ! Philip Sloan, as a true detective, proved Buffon right, 340 years *post factum*. It was otherwise the time that Buffon developed his theory of 'organic molecules', a direct precursor of the cellular theory, which came to flourish in the 19th century. Could research have been more fundamental?

Among the most distinguished optician-mechanics of the day Edmund Culpeper, John Cuff and George Adams called the tune in England, Louis Joblot and Claude Siméon Passement in France, and Georg Brander and Johann Tiedemann in Germany. The Dutch market was dominated by Johan van Musschenbroek and Jacob Huisen, the Austrian by Vinzenz Mazzola, an optician of Italian descent. Italy's continental pre-eminence, in the wake of Galileo, had faded away. It would live a renaissance in the 19th century.

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4	$\frac{11}{100}$	44	1936.
5	$\frac{8}{10}$	26	676.
6	$\frac{1}{2}$	16	256.

Table 1 : *The data closely correspond to those reported by Henry Baker for the scroll-mounted microscope (below, Figure 5). The focal length (longueur du foyer) is expressed in inches (pouces). The magnification (augmentation) is calculated for an eye observing tiny things distinctly at 8 inch distance. The number 8 stems from Huygens, but 10 (not 12) of 'his' inches made a foot. So instead of '8' we should read about '10', which makes for a magnification of ×500 instead of ×400 for the first lens, etc. From: Mémoires [..] de l'Académie Royale des Sciences 1748 (1752), p.228.*

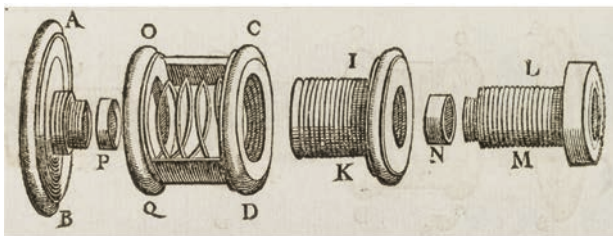

Figure 6 : *Screw-barrel microscope as described by Nicholas Hartsoeker in his Essay de dioptrique (1694). The eye-lens is mounted at P in eye-cap AB which screws in the main body OCDQ. The latter features a spring pushing the object-table (not indicated) against CD. The barrel proper, IK, which serves as condenser, screws in CD and allows the object-table to be brought closer to the eye-lens. A condenser lens is mounted in ring N which screws on LM; the latter screws in IK. LM is not indispensable. By turning IK and LM the object is brought into the two foci involved. Courtesy: University Library Groningen.*

Achromatism: the Van Deijls: 1770-1807

The problem of chromatism was studied from various points of view (Newton, Euler, Klingenstierna). A key-observation, reported i.a. by John Dollond (London, 1758), was the fact that transparent materials not only feature, as plates, different 'mean' refractive powers for white light, but, besides, as prisms or wedges, variously disperse the colours of the spectrum. In other words: different glasses of the same refractive index disperse to different degrees. Dollond found out that an opposed-base combination of a glass prism submerged in a trigonal glass water-bath of adaptable top-angle could be arranged such that an incident white pencil left unchanged. The effect of the water was apparently counteracted by the higher refractive glass. Hence the idea to combine wedges of different kinds of glass, the one less powerful refractive than the other. Dollond found that the refraction by a 25° flint wedge equaled that of a 29° crown wedge, though the dispersion of the colours was very different. By making a *series* of crown wedges he was able to determine the top-angle required to produce the same dispersion as the 25° flint wedge. In the optimal state the refraction of the 25° flint to the optimal crown wedge was as 2 : 3. Hence the idea to attain achromatism – e.g. in a telescope-objective – by combining two spherical lenses, the one biconvex of low-refractive crown, the other plano-concave of high-refractive flint. From 1758 onwards Dollond's telescopes conquered the world. As it happened, a Dollond telescope ended up on the bench of the optician Jan van Deijl, in Amsterdam. Already in 1762 Van Deijl succeeded in constructing something similar and when, in 1772, the patent filed by Dollond expired, the Amsterdam firm – and many others – entered the game. From our point of view it is important that Van Deijl is equally credited with having constructed, in 1770, a microscope on the same principle. Just imagine the smallness of the required objective doublet and you understand the great craftmanship involved. However, in the aftermath of the return of Halley's comet (1758), the bourgeois clientèle was more interested in telescopes, as was the seafaring community. Hence it is that the new microscope came to peter in a cupboard for several decades. Early in the 19th century, then, Van Deijl Jr., who had succeeded his father, came to realize the commercial potential of microscopes, *achromatic* microscopes, that is. While working out a business plan he found out, much to his surprise, that he was virtually the only optician in Europe able to produce such microscopes. In 1807 he reported on the topic and produced a first copy (Figure 7). One of his innovations concerned the upside-down mounting of the achromatic doublet, that is, he directed the almost flat, slightly concave flint side at the specimen, greatly reducing in this way the spherical aberration. He also blackened the inside of the tube to reduce diffuse light. It was reported to produce a magnification of ×96; later checks revealed a resolution of 2 µm.

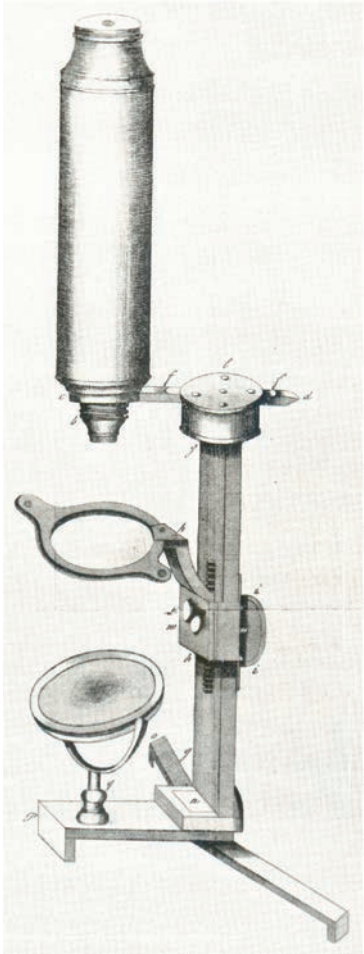

Figure 7 : *The first achromatic microscope produced by Harmanus van Deijl (1807). Van Deijl passed away in 1809. His production is estimated at 7 instruments. Do notice that it is the object table which is used to bring the object into focus, not the tubus. What strikes – apart from the awkward representation – is the fragility of the joint between tubus and pillar. From: Natuurkundige verhandelingen der Kon. Maatschappij der Wetenschappen te Haarlem 3 (2) (1807). Courtesy: University Library Groningen.*

P.S. The author is currently editing the last (fifth) volume of *The collected papers of Frits Zernike (1888-1966)*, which will feature 'Introductions' to the various topics addressed by Zernike, 'Bibliographies' of primary and secundary literature, 'Indexes' (names, subjects), and 'Addenda' (unknown texts which have resurfaced since 2012). The collected papers [...] are EU-distributed by the present author. ■

References:

- J.B. McCormick, Eighteenth century microscopes, Synopsis of history and workbook, Lincoln Wood (IL): Science Heritage Ltd., 1987.
- Ph. Sloan, 'Organic molecules revisited', in: J. Gayon (ed.), Buffon 88, congress proceedings, Paris: J. Vrin, 1992, p.415-438.

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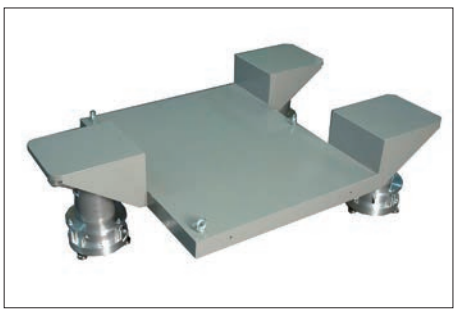
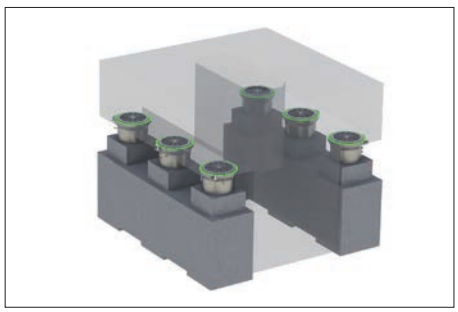


→ *Active vibration isolation platform for SEM and TEM*



→ *Foundation isolation for high resolution applications*

→ *Active magnetic field cancelling system - example of local isolation for SEM*

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REPORTS ON SPECIAL EVENTS

2016 KAVLI PRIZE IN NANOSCIENCE

Awarded to Gerd Binnig, Christoph Gerber, Calvin Quate "for the invention and realization of atomic force microscopy, a breakthrough in measurement technology and nanosculpting that continues to have a transformative impact on nanoscience and technology."

The 2016 Kavli prize in nanoscience is awarded to Gerd Binnig (German physicist and Nobel Laureate), Christoph Gerber (Swiss professor of physics), and Calvin Quate (American engineer and physicist) "*for the invention and realization of atomic force microscopy, a breakthrough in measurement technology and nanosculpting that continues to have a transformative impact on nanoscience and technology.*"

Sculpting and analyzing nanoscale structures are at the core of nanoscience. An ultimate dream had been to position atoms on any surface, one by one, to enable the design and creation of revolutionary new structures. Imaging atomic structures in a wide range of material systems was another visionary concept. The invention of atomic force microscopy has turned these dreams into reality. Atomic force microscopy is now widely used in the fields of physics, chemistry, biology, and materials science.

In atomic force microscopy, a nanoscale tip scans across a sample surface at atomically close range. At the same time, the tiny forces between the sample and the tip are detected. These forces reveal many properties of the sample, such as the arrangement of its individual atoms, now with subatomic resolution. Electric and magnetic interactions, friction, and chemical bonding can induce these forces. The technique is applicable over a wide temperature range and in magnetic fields. Unlike scanning tunneling microscopy, atomic force microscopy can also be applied to insulating materials.

Nanosculpting refers to adding, arranging, and removing atoms to produce desired phenomena and functions. The tip provides a versatile tool for accomplishing such control. Being able to manipulate conductors and insulators at the nanoscale has applications comparable to those of nanoscale 3D printing. Nanostructures created by force microscopy-based techniques include devices in nanoelectronics, nanophotonics, and nanomagnetism.

The advantages of atomic force microscopy include experimenting in liquids such as water, which opens the possibility of exploring biological systems. A single molecule, such as a DNA or a protein molecule, can be suspended between the tip and surface. Lifting the tip stretches and unfolds the molecule. The measured restoring force reveals the molecule's elastic properties and functionality. Biochemical sensors are utilizing the in-situ detection of chemical reactions by temperature-sensitive cantilevers, opening new doors for medical applications. In life sciences, explorations of molecular processes with high resolution advance drug design.

The invention of atomic force microscopy has spawned a wide variety of measurement and manipulation techniques invaluable for many purposes. These range from magnetic force and chemical force microscopy to magnetic resonance spectroscopy, and scanning capacitance microscopy. Another example is friction force microscopy that deepens our understanding of lubrication at the atomic level.

Atomic force microscopy is a powerful and versatile scientific technique that continues to advance nanoscience for the benefit of society. ■

Interview of the laureates by Adam Rutherford: http://www.kavliprize.org/prizes-and-laureates/prizes/2016-kavli-prize-nanoscience

Laureare Nanogroup

2016 MRS INNOVATION IN MATERIALS CHARACTERIZATION AWARD

Frances M. Ross, Niels de Jonge and Chongmin Wang

The innovation in Materials characterization Award honors an outstanding advance in materials characterization that notably increases our knowledge of the structure, composition, in situ behavior under outside stimulus, electronic, mechanical, or chemical behavior, or other characterization feature, of materials.

Frances M. Ross (IBL T.J.Watson Research center), Niels de Jonge (INM- Leibnitz for New Materials) and Chongmin Wang (Pacific Northwest National Laboratory) had awarded for seminal contributions to the imaging of specimens in liquids using transmission electron microscopy, revolutionizing the direct observation of materials processes, batteries during operation and biological structures. ■

Winners Niels de Jonge, Frances M. Ross and Chongmin Wang discuss their award talk: Transmission Electron Microscopy of Specimens and Processes in Liquid.

https://www.youtube.com/watch?v=8i7x2sQ1mgk

2016 EMS OUTSTANDING PAPER AWARD

The seventh round of the EMS Outstanding Paper Award!

By the deadline of January 15, 18 excellent papers had been nominated with a good balance between the different categories. The jury*, chaired by Rik Brydson as non-voting member of the EMS Executive Board, selected a winning paper for each of the three categories of the Award, which was later confirmed by the EMS Executive Board. The following papers received the 2016 EMS Outstanding Paper Award in the respective categories:

1. Instrumentation and Technique Development:

"*Quantum coherent optical phase modulation in an ultrafast transmission electron microscope*", Armin Feist, Katharina E. Echternkamp, Jakob Schauss, Sergey V. Yalunin, Sascha Schafer & Claus Ropers; Nature 521, 200-203 (2015); doi:10.1038/nature14463;

http://www.ncbi.nlm.nih.gov/pubmed/25971512

2. Materials Sciences:

"*Imaging screw dislocations at atomic resolution by aberration-corrected electron optical sectioning*", Yang, H., Lozano, J. G., Pennycook, T. J., Jones, L., Hirsch, P.B., Nellist, P.D.; Nature Communications 6, 7266 (2015); doi:10.1038/ncomms8266;

http://www.ncbi.nlm.nih.gov/pubmed/26041257

3. Life Sciences:

"*Imaging G protein-coupled receptors while quantifying their ligand-binding free-energy landscape*", David Alsteens, Moritz Pfreundschuh, Cheng Zhang, Patrizia M Spoerri, Shaun R Coughlin, Brian K Kobilka & Daniel J Müller; Nature Methods 12, 845-851 (2015); doi: 10.1038/nmeth.3479;

http://www.ncbi.nlm.nih.gov/pubmed/26167642

For the next round, papers published in 2017, a new jury* was elected by the EMS Executive Board. The Board likes to thank the members of the previous jury for their valuable time spent on reading and grading the manuscripts and for their help to shape the success of this new award, and Rik Brydson, chair of the jury during 7 years, for his strong involvement in this award he initiated.

The Executive Board extends its warmest congratulations to all winners and we look forward to a new round of excellent papers for the 2017 competition.

OutPA 2017 – 2019 jury members (judging on papers in 2016 - 2017 - 2018)

- Erdmann Spieker (Institute for Micro- and Nanostructure Research, Erlangen, Germany),
- Francesco Priolo (Università di Catania, Catane, Italy),
- Paul Midgley (University of Cambridge, Cambridge, UK),
- Bruno M. Humbel (University of Lausanne, Lausanne, Switzerland),
- Catherine Venien- Bryan (Université Paris 6, Paris, France),
- Jose-Maria Carazo (Universidad Autonoma, Madrid, Spain).
- Chair: Peter Nellist (University of Oxford, Oxford, United Kingdom)

OutPA 2014 – 2016 jury members (judging on papers in 2013 - 2014 - 2015)

- Alice Warley (King's College, Guy's Hospital London, UK)
- Alberto Diaspro (Optical Nanoscopy, Istituto Italiano di Tecnologia, Genova, Italy),
- Manfred Ruhle (Max Planck Institute fur Metallforschung, Stuttgart, Germany),
- Eva Olsen (Department of Applied Physics, Chalmers, Sweden),
- Christian Colliex (Laboratoire de Physique des Solides, Orsay, France),
- Dirk Van Dyck (Electron Microscopy for Materials Science, Antwerp, Belgium).
- Chair: Rik Brydson (Institute for Materials Research, University of Leeds, UK) ■

* EMS Outstanding Paper Award jury members

Authors of the winning papers received their metal-on-wood plaque at the EMC2016 meeting in Lyon from Rick Brydson.

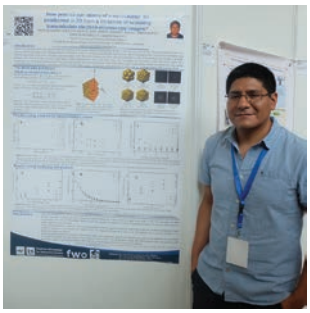
EMS SCHOLARSHIPS

SCHOLARSHIP LIST

EMC2016, August 28 – September 2, 2016, Lyon, France

Name	Society	Lab & Country
Alania Marcos	BSM	EMAT, University of Antwerp, Belgium
Bladt Eva	BMS	EMAT, University of Antwerp, Belgium
Claes Nathalie	BMS	EMAT, University of Antwerp, Belgium
Dembele Kassioge	SFmu	IPCMS Strasbourg, France
Ebner Christian	ASEM	Vienna University of Technology, Austria
Elmas Merve Acikel	TEMD	Acibadem University, Turkey
Fitzek Harald	ASEM	Graz University of Technology, Austria
Haberfehlner Georg	TEMD	Austrian Centre for Electron Microscopy and Nanoanalyis, Austria
Karakulina Olesia	BSM	EMAT, University of Antwerp, Belgium
Knez Daniel	ASEM	Austrian Centre for Electron Microscopy and Nanoanalyis, Austria
Koneti Siddardha	Sfmu	INSA de Lyon, France
Konrad Lukas	ASEM	Graz University of Technology, Austria
Koroglu Pinar	TEMD	Istanbul University, Turkey
Lobato Ivan	BSM	EMAT, University of Antwerp, Belgium
Orthacker Angelina	ASEM	Graz University of Technology, Austria
Pokle Anuj	MSI	Trinity College Dublin, Ireland
Schachinger Thomas	ASEM	Vienna University of Technology, Austria
Schmidt Franz	ASEM	Graz University of Technology, Austria
Sentosun Kadir	BSM	EMAT, University of Antwerp, Belgium
Suyolcu Yusuf Eren	DGE	Max Planck Institute for Solid Research, StEM, Stuttgart, Germany
van den Bos Karel	BSM	EMAT, University of Antwerp, Belgium
Varambhia Aakash M	RMS	University of Oxford, UK
Xiao Juan	Sfmu	INSA de Lyon, France
Zanaga Daniele	BSM	EMAT, University of Antwerp, Belgium

Marcos Alania (Belgium)



From 28th of August to the 2nd of September 2016 the "Lyon Convention center" in Lyon, France, organised and hosted the 16th European microscopy congress. The conference attracts approximately 2000 participants from both academia and industry of different countries around the world that are doing research in fields such as Material science, Life sciences, Instrumentation and methods in electron microscopy (EM).

Six keynote lectures provided a thought provoking core which was fleshed out by approximately 220 research and curriculum development papers, and fringe presentations. A range of posters and displays of curriculum development initiatives provided further stimulation.

From my point of view, the conference was well organised according I was expecting, friendly and productive discussions between the audience and the speakers helped to understand in more detail the lectures. There was also a stand where the companies show their most advanced products in instrumentation, software, and hardware.

The Professor Dr. Angus Kirkland from Oxford university was awarded for outstanding achievements in theoretical and instrumental areas such as pioneering exit-wave reconstruction, EM ptychography, and detector design.

I would like to conclude saying that this was the first EMC conference where I participated and was very productive because I met researchers from different groups that we can collaborate together in new projects, I also take some notes about some lectures that I found interesting and can help me on my own research.

Eva Bladt (Belgium)

Firstly, I would like to thank the European Microscopy Society (EMS) for the financial support, which allowed me to participate at the European Microscopy Conference 2016 (EMC2016) in Lyon. During the conference, I had the opportunity to present my work with two oral presentations ("Advanced characterization of colloidal semiconductor nanocrystals by 2D and 3D electron microscopy" and "Electron tomography based on highly limited data using a neural network reconstruction technique"). The interesting discussions after my presentations gave me some new insights for my future research. By following talks and poster presentations, I learned new aspects which I have no experience in. These events were very helpful and gave me new ideas to look into when arriving back in Antwerp.

Overall, the conference was an excellent meeting and a great motivation to continue my last year as a PhD. Therefore, I would like to thank EMS once more.

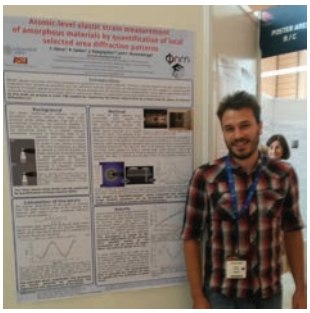
Nathalie Claes (Belgium)

As a young scientist, I believe that it is very important to learn and gain as much experience as possible. Participating at the European Microscopy Congress (EMC2016) was therefore an interesting and excellent event. I would like to sincerely thank the European Microscopy Society (EMS) for the financial support, which allowed me to be part of this congress. EMC2016 was the first congress I ever attended and it has been a great experience.

I envisaged EMC2016 as an opportunity to be surrounded by peers and to be inspired by a large variety of speakers and topics… And that image was completely true. I enjoyed the large amount of interesting talks and posters in a wide range of microscopy topics. Topics similar to my research field, but also very different techniques were discussed. **The high variety of techniques gave me the chance to broaden my perspective, to learn about and get insight in the world of microscopy; in all its dimensions.**

Attending the congress gave me also the opportunity to present my work during an oral presentation entitled "Characterization of Janus gold nanoparticles obtained via spontaneous binary polymer shell segregation". A unique chance to meet a lot of people, to receive feedback based on their own expertise and to have inspiring discussions. I am convinced that EMC2016 was a great learning opportunity. I am looking forward to taking up new challenges that result from this experience.

Christian Ebner (Austria)



The 16th European Microscopy Congress in Lyon, France was a great opportunity to meet with international colleagues and experts in the field of microscopy. According to the organizers "2500 and more participants" attended the conference and made it a big success. It was a large event with a broad spectrum of contributions and a good platform for scientific exchange, especially for young scientists.

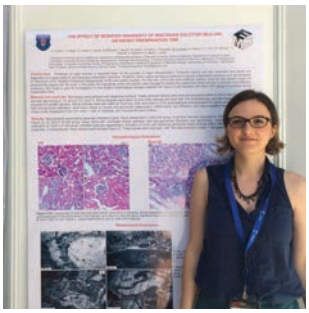
Herewith, I would like to thank the European Microscopy Society for financial support, which allowed me to participate at the congress. This gave me the opportunity to present my results on the "Atomic-level elastic strain measurement of amorphous materials by quantification of local selected area diffraction patterns" to an expert audience in form of a poster presentation. In-situ TEM experiments to characterise materials properties at a local scale are very interesting and an important research topic.

I was pleased to see that there are many people working and sharing the interest in this field. Beside the fruitful discussions during the poster sessions, the congress offered a lot of interesting and inspiring contributions of students and experts from all over Europe allowing the participants to widen their horizon in the rapidly evolving field of microscopy. Not only progress in methodology, but also in the scientific application was presented.

One of my personal highlights was the European Microscopy Award Lecture by Professor Angus Kirkland, who received the price for his many contributions to the field of electron microscopy. In his talk he presented the history of the development of exit wave reconstructions.

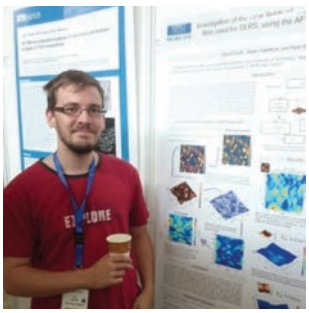
On top of that Lyon was the perfect location for the congress with its elegant cafes along the riverside where you could enjoy the sunshine during the conference breaks. I would like to thank the EMS again for supporting my attendance at the EMC2016.

Merve Elmas Acikel (Turkey)



I would like to thank the European Microscopy Society for their financial support which made it possible for me to participate at the EMC2016 in Lyon, France. It was a great experience for me to take part an international microscopy congress. In the life sciences section during the congress, there were many interesting lectures which I learned a lot of new developments about the microscopy world in different fields. Besides that, I'm very honoured that EMS awarded me with the scholarship to such a great congress, so did offer me the opportunity to present a poster entitled to "The Effect of Modified University of Wisconsin Solution (Mod Uw) on Kidney Preservation Time". In addition, congress lectures and workshops were fascinating and I got the chance to have a look at the exhibitions of companies. Also, I met microscopy experts and I am very happy to had this opportunity to be a part of this organization.

Harald Fitzek (Austria)



I'd like to start by thanking the EMS for the scholarship they granted me to attend the EMC2016 in Lyon. Attending this conference has been a huge opportunity to present a poster (Title: Investigation of the near fields of sputtered Au thin films used for SERS, using the AFM and DDA) about my work on combining AFM measurements with electric field simulations. Attending the EMC was also a huge opportunity for me to learn about a great variety of fascinating developments and research going on in the field of microscopy as well as meeting a lot of interesting people and to establish contacts for possible further cooperation. I'm very glad that I was given the chance to attend this conference and it was a great experience to participate in the session and social events. I hope that I'll be able to attend many more conference and see you guys again!

Georg Haberfehlner (Austria)

The European Microscopy Congress in Lyon was a nice event for me both personally and professionally. Personally, as I have previously done my PhD nearby in Grenoble, and used the opportunity to catch up with friends from that period and enjoy some French specialties I am now missing in Austria. Professionally, as I saw a lot of interesting work on tomography, spectroscopy and plasmonics and had the opportunity to discuss with several colleagues from around the world.

Myself, I could give two oral presentations, one on three-dimensional imaging of particle plasmon fields around metallic nanoparticles and another one on atomic-resolution tomography of gold-silver nanoparticles. I was quite happy that both my presentations were well attended and led to interesting discussions.

I want to thank the European Microscopy Society for supporting my participation at this conference and the organizers of the event **for the excellent organization.** I hope to be also part of the next EMC in Copenhagen four years from now.

Olesia Karakulina (Belgium)

I would like to thank the European Microscopy society (EMS) for providing me a financial support for my participation at the 16th European Microscopy Congress in Lyon (EMC), France. There I presented my work titled as "Quantitative electron diffraction tomography for the structure solution of cathode materials for Li-ion batteries". It was the first time, when I gave a presentation to the audience full of the top scientist and young researchers. Therefore, in the beginning I filled a little bit nervous. However, due to the very friendly atmosphere of the congress, I explained my work also in a friendly manner as I was doing it for my colleagues.

I really enjoyed attending the Materials Science sessions. Especially it was very nice to listen to the talks of invited speakers, which came from all over the world and were showing new horizons of the electron microscopy. I found such talks very inspiring. Apart from this, being a PhD student at University of Antwerpen (EMAT), I was interested to know what kind of research other PhD student do in their microscopy groups. I really like their presentations.

The exhibition was huge, and it was always crowded by curious people. Despite this, I attended several workshops of top leading microscopy companies and learned more about emerging technologies.

I am glad that I got an opportunity to be at EMC. I gain a valuable knowledge, which, of course, I will use to improve my research. I highly recommend the congress to young researchers, since they can learn a lot there.

Knez Daniel (Austria)

First of all, I want to thank the EMS for the scholarship to help with the costs to attend the EMC in Lyon in France. The conference was full of highly interesting talks and posters. I had the pleasure to present my PhD-work in an oral presentation with the title "Atoms in Motion: Electron beam induced dynamics in experiment and simulation". In this work I investigate the possibility to use the electron beam for in situ studies in a controlled manner. I had highly interesting discussions with other experts on my field, some of which are still ongoing. **The questions and suggestions I received during some enjoyable debates will highly influence my future work.**

Overall, I felt that the conference was very friendly and open, despite the large number of delegates. I'm very grateful because my trip to Lyon would not have been possible without the financial support from the EMS.

Siddardha Koneti (France)

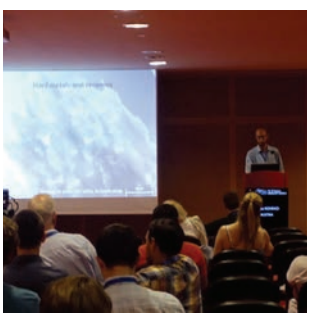
I would like to thank the European Microscopy Society for supporting my participation at the EMC2016 congress held at Lyon in August 2016 by providing an EMS conference grant. The conference was simply amazing. I had a chance to present my PhD work (still in progress) related to In-Situ Electron Microscopy and Electron Tomography in the form of 2 posters.

During EMC2016, the special session on Big data handling was very interesting. Experts from different fields of research showed different approaches that can address the upcoming data issues. In the same perspective, and also from a more scientific and 'microscopy' point of view, I found the talk given by Dr. Eric Betzig (Nobel prize 2014 chemistry) particularly inspiring.

The EMC2016 conference gave young researchers & PhD students (like me) a very good opportunity to experience vibrant tools and techniques in all fields of microscopy in the form of oral presentations, poster sessions, technical workshops and exhibitions as companies and authors came from all over the world. I got a chance to visit hundreds of posters related to my field of study and met other PhD students and researchers who are having similar scientific interests. I had a chance to talk with the professionals and most experienced researchers who gave me some valuable suggestions. **At the end, it was totally satisfying and thus this experience was a worthwhile opportunity for enrichment from the scientific and human points of view.**

I would like to thank again the EMS committee for supporting my candidature for the grant.

Lukas Konrad (Austria)



First of all I would like to thank the EMS for financial support, which made it possible for me to attend the EMC2016 held in Lyon from August 28th until September 2nd. The congress was a great opportunity to present my latest results in an oral presentation. Not only was it a good chance to improve my presenting skills but also to have fruitful discussions afterwards. **The conference was perfectly organized.** I attended many presentations and plenary lectures and it was very interesting to hear different approaches on methods, instrumentation and material science related topics. **Also the location was fantastic and Lyon definitely worth a visit.** I am hoping to attend more EMC Conferences in the future.

Pinar Köroglu (Turkey)

First of all, I would like to thank the European Microscopy Society for the scholarship which allowed me to participate at the 16th European Microscopy Congress (EMC) in Lyon. I am a PhD student at Istanbul University, Faculty of Science, Department of Biology. I am working on the diabetes and cancer association in my PhD thesis project. I was very pleased to learn that I had been selected as the recipient of your scholarship. Bursary position offered me the opportunity to present a poster on "Metformin ameliorates testicular damage in diabetes and prostate cancer model". European Microscopy Congress consisted of 2 500 visitors from 51 countries all over the world. Congress programme has promoted a multi-disciplinary approach, all techniques, life sciences, material sciences and instrumentation- methods sessions.

I was very glad with the organization and execution of the congress. I had also have chance to look at state of microscopes and accessories, met colleagues and discussed other people's research during poster sessions and discussion. **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.** In addition, I have met major microscopy experts with fascinating workshops and I am very grateful to had this opportunity to get detailed information about microscopy. To sum up with, as a PhD student, this participation became a great asset for me and an inspiration too. The feedback I received was both stimulating, encouraging and gave me new ideas about my research. I'm looking forwards to the next one already!

Angelina Orthacker (Austria)

For a young scientist it is a very enriching experience to take part at a scientific congress such as the EMC in many ways. You gain a new perspective on your own work by finding a way of presenting it to a scientific audience in only 15 minutes. **The adrenaline rush you feel when you live through your 15 minutes of fame is exhilarating.** And the rest of the day, when you can live on the high of having accomplished your mission, is rewarding.

But it's not all just about the one big day. It's also about sitting in the audience finding interest in new fields. Having inspiring discussions at posters and with exhibitors. Meeting colleagues/friends you got to know at previous conferences and courses and finding out how their research developed. Furthermore the participation at the congress also strengthens the bond to the colleagues of your own institute. And in case of the EMC2016 we also got to know the wonderful city of Lyon.

Due to all of that (and many more memorable details) I would like to thank the EMS for supporting my participation at the EMC2016. Thank you for enabling my living through so many interesting experiences and the creation of many wonderful memories.

Thomas Schachinger (Austria)

The EMC2016 in Lyon was a very valuable and important conference for me. By experience, conference time is always a very special time in the year of a researcher and so was also the time in Lyon.

Prior to the EMC a colleague of mine and I took the chance to discover Lyon. We walked the **beautiful Rhône riverside, "climbed" the La Croix-Rousse hill with its narrow, crooked streets and impressive panoramic views, visited the catacombs of the impressive basilica of Notre-Dame de Fourvière** or as the locals call it more indigenous the lying elephant and stumbled through the lively historic city centre. And, by that we prepared ourselves a warm and nice welcome to Lyon.

At the EMC, my colleagues and I were extensively using the chance to meet the manufacturers of electron microscopes, energy filters, cameras, sample preparation tools and dual beam machines at the exhibition area, e.g. via live demonstrations and lunch time lectures. This gave us an impression of the latest developments and innovations in this field, as well as an insight in the usability and performance of these machines. The presence of the manufacturers also gave us the opportunity to clarify technical hardware and software issues.

I enjoyed the plenary talks especially those of **Eric Bletzig** about the revolutionary PALM technique and **Johan Verbeeck**'s thoughtful update and outlook to what could be one of the next revolutions in electron microscopy. Also in the oral presentation sessions, there were some very interesting research reports, like the temperature measurements in the TEM using electron diffraction by **Florian Niekiel**, the remarkable imaging STEM technique from **Florian Krause**, the realization of a Aharonov-Bohm setup using electron vortex beams by **Vincenzo Grillo**, the stunning insights on quantum coherent electron-light interactions from **Claus Ropers** and the report on the implementation of a ultrafast cold field emission source from **Florent Houdellier**. The poster presentation sessions provided a great opportunity to meet "old" friends from all over Europe and even turned out to be a good platform to get to know colleagues from overseas, which were not present at the IMC or the last two MC's, and exchange ideas and thoughts with them.

All in all, the EMC and to a great extend also the wonderful city of Lyon were an inspiring and very pleasing environment for learning, making contacts, presenting, planning cooperations and experiments and thinking of future projects. With that I want to appreciate the EMS for awarding me the EMS scholarship.

Franz-Philipp Schmidt (Austria)

From 28th August to 2nd September 2016 I was allowed to present our newest results at the EMC2016 in Lyon within an oral contribution. It was not only an interesting experience to share our latest findings with experts

of my research field, i. e. electron energy loss spectroscopy (EELS) and cathodoluminescence (CL), it also gave me the possibility to socialize with those experts, who were only known as the authors behind the papers on my research topic.

I'm very thankful for the financial support, which was given by the EMC and **I would like to emphasize that this kind of young researcher's support absolutely makes sense,** as it motivates young researchers to participate in such very interesting conferences, which is important for a possible career in research and science.

Kadir Sentosun (Belgium)

Firstly, I would like to thank the European Microscopy Society(EMS) for helping me to attend the European Microscopy Congress held in Lyon, France through the EMS scholarship. I had the opportunity to present my poster entitled 'Multi ADF detector tomography for 3D characterization of heterostructures'.

Also EMS gave me the opportunity to watch invaluable lectures from different research groups around the world from which I learned a lot. I would like to thank EMS and organizers for this special event for giving me the opportunity to present my work and discuss the future aspects with fellow researchers.

Y. Eren Suyolcu (Germany)

One of the most important organizations in the field of microscopy was held in Lyon, FRANCE within 28th August - 2nd September. The 16th European Microscopy Congress (EMC2016) was quite attractive and interesting not only from the microscopic point of view but also from the materials science and applications and allowed me - like the other young researchers - to update my knowledge with the latest developments and trends in electron microscopy.

During the conference, I had the chance to attend many attractive and informative lectures, especially in "Oxide-based, Magnetic and Other Functional Materials" session which are in a strongly related to my PhD thesis. I should also underline that I am honoured to be awarded a scholarship to attend such an important congress and it was a great opportunity to give a talk on my recent studies with the title: "Structural and Chemical Investigations of Superconducting $La_{1.6}M_{0.4}CuO_4/La_2CuO_4$ Bilayer Interfaces."

As a PhD student, having fruitful discussions with the experts of electron microscopy as well as other young scientists from all over the world working on different topics was a great experience. **I have also visited the well-organized exhibition hall where new developments from the companies were nicely exhibited.** Lastly, it should also be stated that the conference became a wonderful meeting thanks to the valuable support of the organizers.

Therefore, I would like to thank EMS for their financial support to participate the EMC2016.

Karel Van den Bos (Belgium)

First of all I would like to thank the EMS for awarding me the scholarship to attend the EMC2016 in Lyon. The conference has been a great experience. Especially, the possibility to see all the new developments has been wonderful. I have had the pleasure to present my own results in both an oral lecture and a poster session. The large audience that attended my oral lecture and the many people that were interested in my poster were a real nice surprise to me.

The best part about the conference was the opportunity to meet and discuss with the experts and other young scientists that are working in the field of electron microscopy. The discussions were fruitful and gave me lots of new ideas to work on in the future. Overall, this conference was a great learning opportunity and gave me even more motivation for my further research. I would also like to thank the organizers of the conference for a well-organised and attractive conference.

I am already looking forward to the next microscopy conference.

Aakash M Varambhia (UK)

At the JEOL Party
From Right to Left:
Dominique, Kate, Chen, Tim and Me (Aakash)

As a PhD student who is about to commence his third year, EMC was the largest conference I had attended yet. It was also my first time travelling to France, and Lyon was the perfect introduction to the country. As soon as I arrived at my hotel I embarked on a walking tour around along the river (the confluence area) which I greatly enjoyed.

The conference began on a Sunday evening at the Lyon convention centre. The opening reception talk was held in its grand amphitheatre and was well attended. This was then followed by a big data in microscopy workshop and a plenary lecture. Throughout the conference I attended many interesting talks.

My favourite session was the quantitative microscopy section; the invited speaker quality was very good as most of the key researchers within the field were present. A lot of the talks made me reflect upon my work, discuss new ideas and gauge where I stand within my field. This was extremely useful as I am approaching the final stretch of my PhD.

I presented a poster at the conference, along with over 300 other presenters. My research focuses on using STEM and spectroscopy to characterize catalyst nanoparticles at atomic resolution using the best techniques available. My poster was a summary of my PhD project containing my most substantial results using a combination of the best practice methodologies for quantitative atom counting and characterization. This was my best poster yet and I was happy with the reception it received and I was grateful to get valuable feedback on suggested areas of improvement.

While the number of posters and presenters was overwhelming, I was excited to meet everyone. It was refreshing to be reunited with several colleagues who I had met at other conferences and summer schools here. I believe this is the best part of the conference for students, where long term relationships between colleagues are formed internationally across all disciplines.

When I wasn't attending the talks I was browsing the manufacturer's booths for the latest tech within microscopy and attending product demos. I was fortunate enough to get an invitation to the JEOL company dinner and the FEI company after-party, both offered generous portions of food and drinks (thanks to both companies for that!). In addition to this there was also the conference dinner with live singers and dancers. The congress dinner provided a great opportunity to network and meet new people as well as experience the night life around the confluence area.

Overall the conference was excellent in terms of outreach and it could not have come at a better time within my PhD. I would like to thank the RMS and EMS for financial support to attend the conference, due to this funding I was able to obtain the full conference package and enjoy the conference wholly.

Juan Xiao (France)

I am Juan XIAO, a PhD student of INSA-Lyon in France. Firstly, I want to thank the EMS scholarship for supporting my participation to this EMC2016 conference. This conference opened a wide door for the people working on microscopy, especially for the PhD students and young researchers. The researchers from all over the world brought their recently research results on different field of microscopy, **many ideas brought me great help to my own work.** I gave an oral presentation on environmental tomography of liquid latex suspensions in STEM. After my presentation, several researchers came to me for discussing my work. Their questions gave me some helpful ideas for my future work.

Congratulations on this successful conference! And I am looking forward to the next EMC in four years!

Daniele Zanaga (Belgium)

I would like to thank the European Microscopy Society for supporting my participation at EMC2016. The conference was an interesting experience, I met different colleagues involved in the same research field, attended lectures on new and interesting topics and generally got updated on the hottest topics.

During the conference I had the opportunity to share part of my work through a poster and an oral presentation and got in contact with people interested in it, which will hopefully lead to new collaborations and further development. Furthermore, I also enjoyed the **perfect organization of the conference, and the beautiful city of Lyon**, so thanks again EMS! ■

FINANCIAL REPORT OF EMS BUDGET

EUROPEAN MICROSCOPIES SOCIETIES

EUROPEAN CORPORATE MEMBER ASSEMBLY

EMS CALENDAR 2017

APPLICATION FOR MEMBERSHIP

EUROPEAN CORPORATE MICROSCOPY ASSEMBLY (ECMA)

FINANCIAL REPORT OF EMS BUDGET

Financial report of EMS budget presented at the EMS board meeting in Toulouse, 03-08-2017.

Budget 2016 final, budget 2017 running, budget 2018 outlook.

Budget 2016, final

Incomings

The majority of incomings came from contributions of the national societies and the ECMA members with further incomings from individual members, interest rates and from job postings for non-EMS members.

In summary, an amount of **€ 47 322.84** was accrued.

Expenses

EMS granted 24 scholarships to young scientists for their attendance at the EMC2016 in Lyon (in sum € 6 000) and EMS sponsored three supported meetings (in sum € 2 250). Two board meetings were held, one embedded in the EMC and one extra meeting in March in Antwerp (in total € 3 480.05). The professional secretarial support generated costs of € 22 560 and the three Outstanding Paper Awards added up to € 3 000.00.

Together with bank costs, a transient position (EM Award; € 6 000 re-imbursed by JEOL) we had a total of expenses of **€ 43 334.90**. Thus, the balance for 2016 ended with a surplus of **€ 3 987.94**. At the end of the year, EMS had **€ 69 828.44** at the savings deposit. As of December 31st, 2016, EMS had total assets of **€ 96 730.82**.

Budget 2017, running; (as of February 15th, 2017)

Incomings

The major revenues will again be accrued by the annual contributions of EMS members of the national societies and of ECMA members. Invoices were sent out to all our ECMA members and will be issued to national societies once the membership database has been updated. Notably, from this year onwards the membership fee is 7 € per member instead of the previous 5 €. This year, we will receive revenues from the successful EMC2016 in Lyon, estimated to reach € 23 800. Further incomings will be accrued by individual members, interest rates and, possibly, by job postings for non-EMS members.

Together, incomings can be expected to amount to **€ 73 200**.

Expenses

There will be two EMS extension meeting this year (MC Lausanne and MCM Rovinj), each supported with € 1 500. EMS can sponsor up to 10 supported meetings (in sum € 7 500) and can issue up to 50 scholarships for attendance at MC, MCM or else (in sum € 12 500). Further expenses will include the Outstanding Paper Awards (€ 3 000), two board meetings, one extra meeting in Toulouse in March and one embedded at MC2017, professional secretarial support and bank costs. Thus, expenses are estimated to amount to **€ 57 350**.

It is thus calculated to end the year 2017 with a surplus of € 15 850.

Budget 2018, proposal

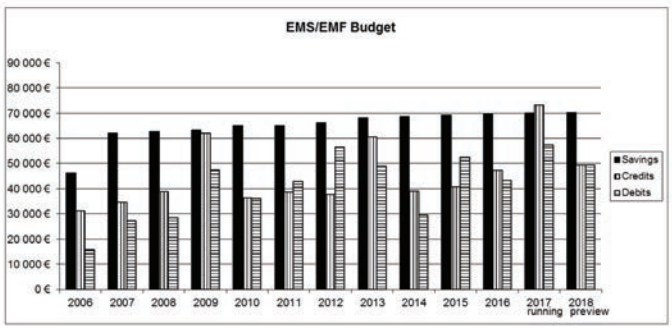
Incomings

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 **€ 49 350**.

Expenses

EMS can support one extension meeting and eight sponsored meetings (in total € 7 500) and can issue 32 scholarships for travel support (in total € 8 000). 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 **€ 49 350**.

It is thus calculated to end the year 2018 with a balanced budget. ■



Christian Schöfer, m.p.
Treasurer EMS/EMF

Vienna, 15th February 2017

EUROPEAN MICROSCOPIES SOCIETIES

Number of EMS Members by Societies (2016)			
National and regional societies			Number of members
Armenian Electron Microscopy Society	AEMS	Armenia	**8**
Austrian Society for Electron Microscopy	ASEM	Austria	**171**
Belgian Society for Microscopy	BSM	Belgium	**312**
Croatian Microscopy Society	CMS	Croatia	**88**
Czechoslovak Microscopy Society	CSMS	Czech Republic	**268**
Dutch Society for Microscopy	NVvM	Netherlands	**228**
Electron Microscopy and Analysis Group (Institute of Physics)	EMAG	United Kingdom	**314**
French Microscopy Society	SFμ	France	**447**
German Society for Electron Microscopy	DGE	Germany	**396**
Hellenic Microscopy Society	HMS	Greece	**60**
Hungarian Society for Microscopy	HSM	Hungary	**111**
Israel Society for Microscopy	ISM	Israel	**277**
Italian Society of Microscopical Sciences	SISM	Italy	**356**
Microscopical Society of Ireland	MSI	Ireland	**117**
Nordic Microscopy Society	SCANDEM	Scandinavia	**281**
Polish Society for Microscopy	PTMi	Poland	**109**
Portuguese Society for Microscopy	SPMicros	Portugal	**52**
Romanian Electron Microscopy Society	REMS	Romania	**78**
Royal Microscopical Society	RMS	United Kingdom	**1 300**
Serbian Society for Microscopy	SSM	Serbia	
Slovene Society for Microscopy	SDM	Slovenia	**153**
Spanish Society for Microscopy	SME	Spain	**279**
Swiss Society for Optics and Microscopy	SSOM	Switzerland	**267**
Turkish Society for Electron Microscopy	TEMD	Turkey	**65**
Corporate members EMS (51 societies)	ECMA		**70**
Individual members	IND		**37**

EUROPEAN CORPORATE MEMBER ASSEMBLY

Corporate members 2016 list

Platinum members

- Diatome Ltd
- JEOL Europe

Gold members

- Andor Technology
- DELONG INSTRUMENTS a.s
- FEI
- Hirox Europe
- Hitachi High-Technologies
- Leica Microsystems
- TESCAN ORSAY HOLDING, a.s.

Silver members

- Akademiai Kiado
- Bruker Nano GmbH
- Carl Zeiss Microscopy GmbH
- Deben UK Ltd
- Electron Microscopy Sciences
- Gatan
- HWL Scientific Instruments GmbH
- NanoMEGAS
- Oxford Instruments GmbH
- Quorum technologies
- SPI Supplies
- Ted Pella, Inc.
- Thermo Fisher Scientific
- VIB&TEC

Bronze members

- Advanced Microscopy Techniques
- Agar Scientific
- CEOS
- DENSsolutions
- EDAX
- EMSIS GmbH
- EO Elektronen-Optik-Service GMBH
- Eumex Instrumentebau GmbH
- Fischione Instruments
- iLab Solutions
- ISS Group Services Ltd
- JSC Nanopromimport
- Klocke Nanotechnik
- Märzhäuser Wetzlar GmbH & Co. KG
- Micro to Nano
- MICROS Produktions - und Handelsges. m.b.H.
- Microscopy Improvements e.U.
- Olympus Nederland B.V.
- Phase Focus Limited
- Physik Instrumente UK Ltd
- Protochips
- Science Services GmbH
- SmarAct GmbH
- Spectral Solutions AB
- TVIPS - Tietz Video and Image Processing Systems
- Tissue Gnostics
- Wiley-VCH
- XEI Scientific Inc.

EMS CALENDAR 2017

EMC Extensions

Microscopy Conference 2017 (MC 2017)

August 21 – 25, 2017

Lausanne – Switzerland

Microscopy conference jointly organised by: SSOM Swiss Society for Optics and Microscopy ASEM, Austrian Society for Electron Microscopy DGE, German Society for Electron Microscopy.

13th Multinational Congress on Microscopy (MCM 2017)

September 24 – 29, 2017

Rovinj – Croatia

EMS lectures at Rovinj:

Elvio Carlino

Rome – Italy

Eric Stach

Upton, NY – USA

EMS Sponsored Events for 2017

Annual Conference of the Nordic Microscopy Society (SCANDEM 2017)

June 5 – 9, 2017

Reykjavik – Iceland

Advanced Course on Cryo-Electron Tomography

May 6 – 12, 2017

Vienna – Austria

Electron Microscopy with High Temporal Resolution (EMHTR 2017)

May 29 – 31, 2017

Strasbourg – France

4th Edition of Quantitative Electron Microscopy School (QEM2017)

May 22 – June 2, 2017

Balaruc-les-Bains, Etang de Thau – France

15th International Congress of Histochemistry and Cytochemistry

May 18 – 21, 2017

Antalya – Turkey

NOTES

APPLICATION FOR MEMBERSHIP

EUROPEAN MICROSCOPY SOCIETY (EMS)

Individual Member Subscription form

Individual membership of the European Microscopy Society is open to all microscopists for €25 per year. Note that the membership fee is €5 for members of European national microscopy societies. Please complete and return the following form* to:

Virginie Serin, Secretary EMS, CEMES - CNRS
Centre d'Élaboration de Matériaux et d'Etudes Structurales (UPR 8011)
29, rue Jeanne Marvig, BP 94347, 31055 Toulouse Cedex 4, France
email: virginie.serin@cemes.fr , Fax: +33 (0)5 62 25 79 99

Prof./Dr./Mr./Ms.: _____ Last Name: _____

First Name: _____

Institute: _____

Department: _____

Address: _____

Zip code: _____ City: _____

Country: _____

Tel.: _____ Fax.: _____

E-mail address: _____

Website: _____

I will transfer 25 € in favour of account: 4443344 (ING/Postbank) of EMS, St.Radboud, PO Box 9101, NL-6500 HB Nijmegen, The Netherlands. Swift code: INGBNL2A, IBAN: NL46INGB0004443344.

Please mail or fax a copy of your bank transfer statement to:

Prof. C. Schöfer, EMS Treasurer, Medical University of Vienna, Austria,
Tel: (+43)14 0160 37713 Fax: (+43)14 0160 937799,
email: christian.schoefer@meduniwien.ac.at

Date / Signature: _____
* please print for clarity

EUROPEAN CORPORATE MICROSCOPY ASSEMBLY (ECMA)

Subscription form

To subscribe to the ECMA, please complete this form* and mail or fax to:
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Centre d'Élaboration de Matériaux et d'Etudes Structurales (UPR 8011)
29, rue Jeanne Marvig, BP 94347, 31055 Toulouse Cedex 4, France
email: virginie.serin@cemes.fr , Fax: +33 (0)5 62 25 79 99

Prof./Dr./Mr./Ms.: _____ Last Name: _____

First Name: _____

Representing the Company: _____

Address: _____

Zip code: _____ City: _____

Country: _____

Tel.: _____ Fax.: _____

E-mail address: _____

Website: _____

We select the following category (thick one)

- ○ Platinum minimum 1.000 €
- ○ Gold 500 €
- ○ Silver 250 €
- ○ Bronze 100 €

and will transfer the corresponding amount in favour of account: 4443344 (ING/Postbank) of EMS, UMC St.Radboud, P.O. Box, 9101, 6500 HB Nijmegen, The Netherlands.

Swift code: INGBNL2A
IBAN: NL46INGB0004443344

Please mail or fax a copy of your bank transfer statement to christian.schoefer@meduniwien.ac.at , EMS Treasurer, Prof. C. Schöfer, Medical University of Vienna, +43 14 0160 937799

Date / Signature: _____
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