European Microscopy Society

Yearbook 2010

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European Microscopy Society

Yearbook

Compiled by Marie Cheynet

Laboratoire de Science
et Ingénierie des Matériaux et Procédés
UMR CNRS – Grenoble Université
PHELMA Campus B.P. 75
38402 GRENOBLE - France

Secretariat:
Prof. Dr D. Schryvers
EMAT, Dept of Physics
University of Antwerp, Groenenborger Campus
Groenenborgerlaan 171
B-2020 Antwerp (Belgium)
Tel: +32 32 65 32 47
Fax: +32 32 65 33 18
E-mail: nick.schryvers@ua.ac.be

Website: http://www.eurmicsoc.org

Yearbook 2010

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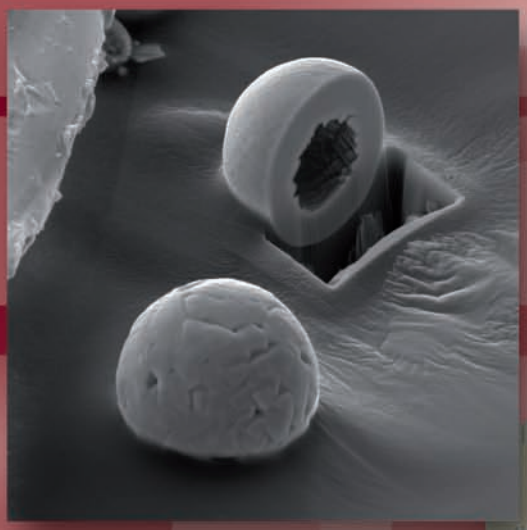

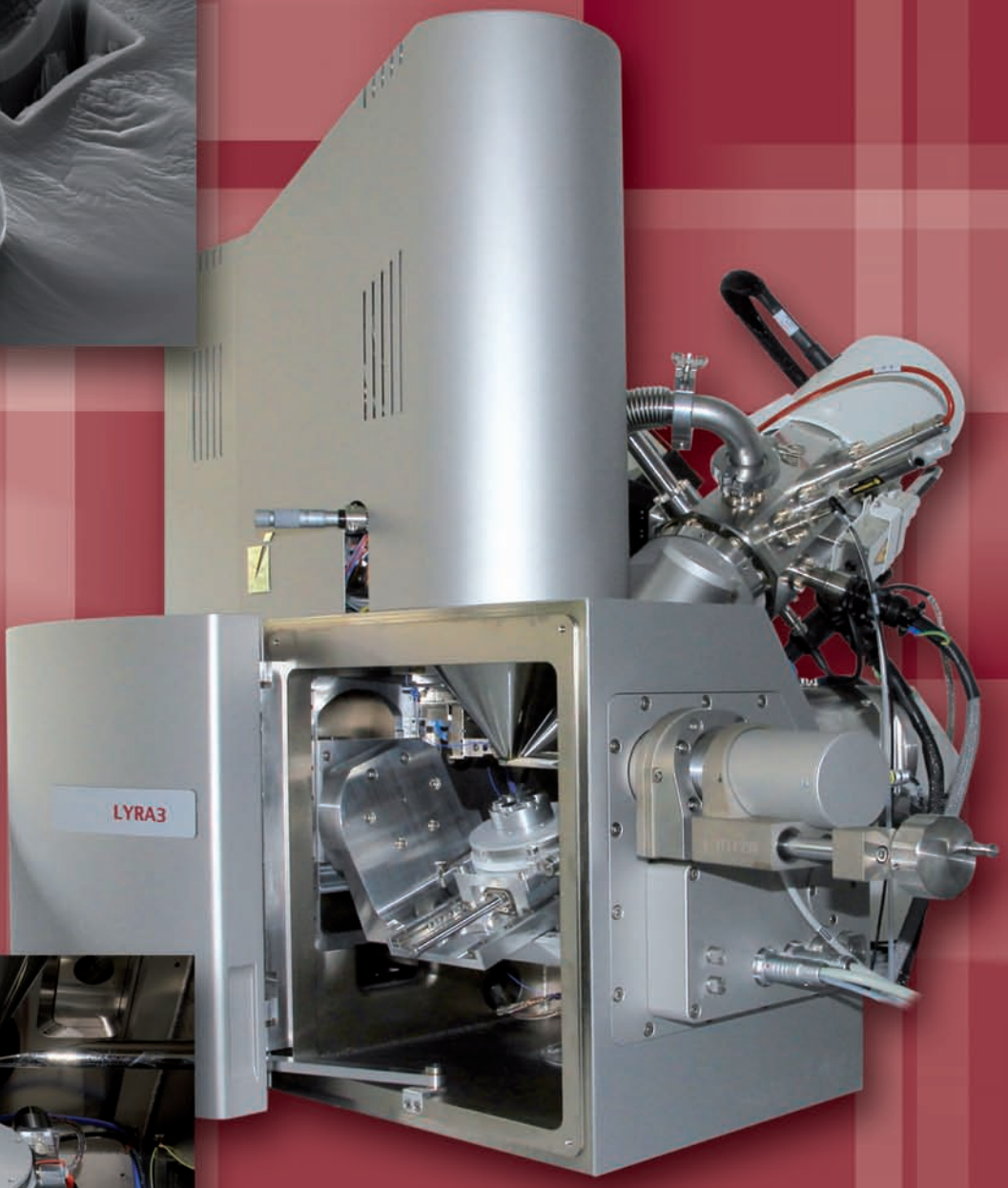

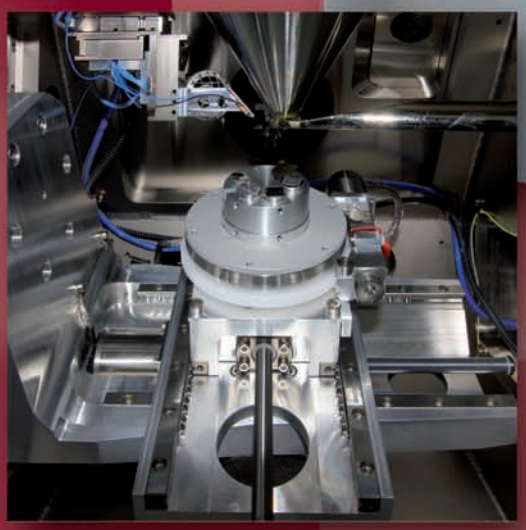

TESCAN

PERFORMANCE IN NANOSPACE

Preface

I have the pleasure to present you the new version of the EMS directory. For the first time our usual "EMS Yearbook" primarily containing the membership address list will be replaced by a true yearbook containing reports of several activities of the society. Since the EMS members list as well as the status and different sections related to the procedures to request supports or scholarships can these days be found on-line on the website (http://www.eurmicsoc.org/), all these parts have been deleted. They are now replaced by short and illustrated reports focussed on specific scientific events sponsored by the EMS and manifestations organized for the attention of some members who have particularly marked microscopy during their career. Of course, as usual you will find the message of our President Paul Midgley and severals reports on i) the finances which are managed by the treasurer Christian Schöfer, ii) the events or people who have been supported for the organization of schools, workshops, congress, …, iii) the scholarships offered to young microscopists to participate to different meetings with short summarizes of their talks or posters and iv) the awards (money, diploma, medal) attributed to members for a noticeable work in EM.

First of all I would thank all those who collaborated to this new 2010 EMS Yearbook by sending me texts and images and I would thank Nick Schryvers (EMS secretary) and Gert Beyers who have helped me to compile and organize the layout. I would also warmly thank Peter Hawkes who is at the origin of the EMS Yearbook and has insured its publishing in partnership with the ERI company from the beginning till 2008. As Peter was, I am convinced that today still, and in spite of the ease of the electronic communication, it is neccesary to keep a tangible contact with all the EMS members through a conventional communication support. The way to do this is to perpetuate the Yearbook in a more modern version. I hope that you will enjoy this new version and I invite you to contribute to its content in the future.

As previously the realization of this issue was ensured by the company ERI/SCE and as always this publication will be free of charge for our society, thanks to the many companies who advertise in our pages to support it.

Marie Cheynet

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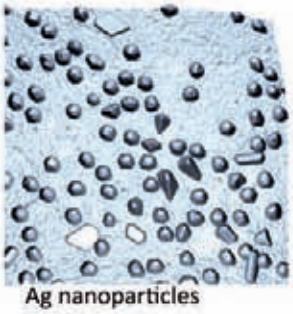
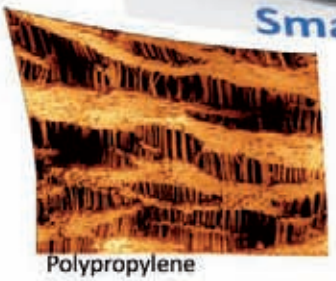
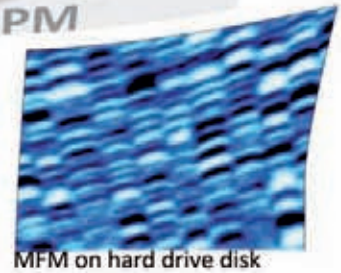


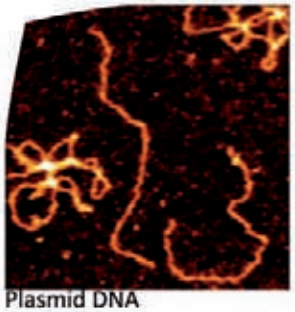
Ag nanoparticles
3.6×3.6 µm



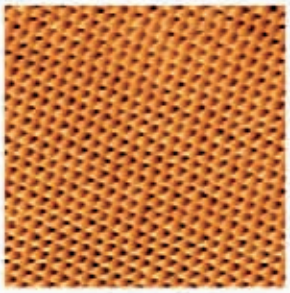
Polypropylene
2x2 µm



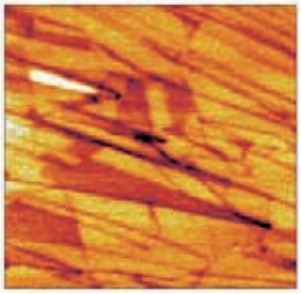
MFM on hard drive disk
1,8x1,8 µm



Plasmid DNA
300x300 nm

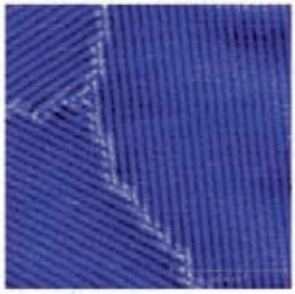


Atomic lattice of HOPG
32x32 angstroms



Kelvin Probe Microscopy on HOPG
6x6 µm

Lithography on GaAs film
3x3 µm



Alcane layer $C_{28}H_{58}$
100x100 nm

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EXECUTIVE BOARD of EMS

PRESIDENT

Prof. Dr. Paul Midgley
University of Cambridge
Department of Materials Science
Pembroke Street - Cambridge CB2 3QZ - UK
Tel: (+44) 122 333 4561 - e-mail: pam33@cam.ac.uk

PAST-PRESIDENT

Prof. Dr. Ueli Aebi
M.E. Müller Institute
Biozentrum, University of Basel
Klingelbergstrasse 50/70 - CH-4056 Basel - Switzerland
Tel: (+41)-61-267.22.61-60 - E-mail: ueli.aebi@unibas.ch

SECRETARY

Prof. Dr. Dominique (Nick) Schryvers
EMAT University of Antwerp, CGB
Groenenborgerlaan 171 - B-2020 Antwerp - Belgium
Tel: (+32)-3-265.32.47 - Fax: (+32)-3-265.33.18 - E-mail: nick.schryvers@ua.ac.be

TREASURER

Prof. Dr. Christian Schöfer
Center for Anatomy & Cell Biology
Medical University of Vienna
Schwarzspanierstraße 17 - AT-1090 Vienna - Austria
Tel: (+43) 14 277 61338 - E-mail: christian.schoefer@meduniwien.ac.at

CHAIR EMC 2012

Dr. Debbie Stokes
BSS
University of Cambridge - Department of Physics - Cavendish Laboratory
JJ Thomson Avenue - CB3 0HE Cambridge - UK
Tel: (+44)- 7920.711.972 - e-mail: djs49@phy.cam.ac.uk

PRESIDENT EMC 2008

Prof. Dr. Joachim Mayer
Central facility for Electron Microscopy (GFE)
RWTH Aachen University
Ahornstrasse 55 - D-52074 Aachen - Germany
Tel: (+49)-241-802.43.45 - E-mail: mayer@gfe.rwth-aachen.de

ECMA representative

Dr. Bob Hertsens
JEOL (Europe) B.V.
Planet II, Bldg B – Leuvensesteenweg 542
B-1930 Zaventem - Belgium
Tel: (+32)-2-720.05.60 - E-mail: hertsens@jeolbenelux.com

MEMBERS

Prof. Dr. Serap ARBAK
Department of histology and Embryology
Acibadem Univ. Medical Faculty
Maltepe, Istanbul - Turkey
Tel: (+90)-216.458.08.26 - E-mail: arbaks@yahoo.com

Dr. Rik BRYDSON
Institute for Materials Research
University of Leeds
Leeds LS2 9JT - UK
Tel: (+44)-113-343.23.69 - E-mail: mtlrmdb@leeds.ac.uk

Dr. Ing. Marie Cheynet
SIMaP
UMR-CNRS, INP-PHELMA, UJF
1130 Rue de la Piscine - BP 75 Domaine Universitaire - F-38402 Grenoble Cedex - France
Tel: (+33)-476-82.66.08 - E-mail: marie.cheynet@simap.grenoble-inp.fr

Prof. Dr. Aleksandra Czyrska-Filemonowicz
AGH University of Science and Technology
al. Mickiewicza 30
30059 Krakow - Poland
Tel: (+48)-12-617.29.29 - E-mail: czyrska@agh.edu.pl

Prof. Dr. Pavel Hozak
Institute of Molecular Genetics
Videnska 1083
142 20 Prague 4 - Czech Republic
Tel/Fax: (+420) 241 06 22 19 - E-mail: hozak@img.cas.cz

Prof. Dr. Raija Sormunen
University of Oulu
Biocenter Oulu
Aapistie 5A - PO Box 5000 - 900 14 Oulu - Finland
Tel: (+358)-85-3756112 - E-mail: Raija.Sormunen@oulu.fi

Prof. Dr. Marco Vittorio-Antisari
ENEA, INN-NUMA
C.R. Casaccia
C.P. 2400 - 00100 Roma - Italy
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FROM THE PRESIDENT...

Dear EMS member,

It is with great pleasure that we introduce the new EMS Yearbook to you. Due to the start-up of the on-line EMS membership database at *ems.ua.ac.be* membership information can now be retrieved by any member and so a printed list of addresses is no longer necessary. This not only reduces the Yearbook volume, cutting costs and environmental impact, but also allows for some new items to be introduced. One of those is the series of selected EMS scholarship reports which you will find throughout this Yearbook. Reports of special microscopy events in Europe have also found a place in the new layout.

In the past year quite a number of matters and events happened that were of importance to the European Microscopy Society. The most exciting was probably the selection of 'Magical Prague' as the venue for IMC18, the next International Microscopy Congress in 2014. As you may remember, EMS started a pre-selection process after the IMC16 meeting in Sapporo to try to optimize the chances of the next IMC coming to Europe. This process, which led to the Prague bid winning EMS support, appears to have paid-off with many delegates at the IFSM General Assembly in Rio de Janeiro strongly supporting the Prague bid. Pavel Hozak, chair of IMC18, and Martin Sasik from Guarant did a great job in putting together a bid of high intrinsic quality and in promoting Prague during the bid presentations. As a result, 'Magical Prague' was elected with a large absolute majority after the first round of voting clearly indicating the attraction of the bid to many delegates, not just in Europe but around the world. We once more congratulate the Prague team headed by Pavel and Martin, thank all EMS members for their support and we look forward to a wonderful IMC18 in the heart of Europe.

In the mean time EMS continues to sponsor many European meetings in different ways. In 2010 two multi-national congresses were selected as EMS Extensions: **MICRO**SCIENCE in London and SCANDEM in Stockholm. In this Yearbook you will find detailed reports on these meetings as well as lecture notes of some of the presentations sponsored by EMS. Aside from the large EMS Extensions, EMS has financially supported 8 meetings on microscopy or with an important microscopy component. Some short reports of these meetings can also be found in this Yearbook.

As mentioned above, new to this year's Yearbook are selected reports from young researchers who have received EMS scholarships to attend one of the EMS Extensions or the IMC17 in Brazil. These reports clearly show the enthusiasm of these young microscopists for scientific research in our ever-growing field. This year, EMS has provided 9 scholarships of 250 € for MICROSCIENCE, 7 of 250 € for SCANDEM and 15 of 500 € for IMC17, the latter with the much appreciated support of JEOL.

In the coming year the preparations for EMC 2012, hosted by the RMS in cooperation with EMAG, will increase steadily. In late September 2010 it started to become clear that the arrangements with the proposed ExCeL site in London could not be finalized due to a possible overlap with reservations made by the Olympic organization running into the EMC exhibition set-up period. The local organizers decided to look for possible alternative sites to host EMC in London and elsewhere in the UK. After a detailed search, an excellent opportunity emerged in the form of the award-winning Manchester Central Convention Complex, based on the remodelled Victorian central train station in the heart of the city of Manchester. After a visit from a delegation of the RMS and EMS Boards, including representatives of the trade, it was evident that this Centre offered everything necessary for a superb microscopy congress, including ample space for exhibition, posters, plenary lectures and parallel sessions and all within an extremely convenient central location. Moreover, Manchester and its surrounding area is a booming region, known particularly for sports and music, easily reached from almost all major European cities and can act as

...AND THE SECRETARY

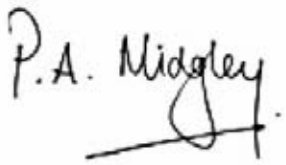
a hub for many interesting and fun pre- and post-congress activities. Since a decision needed to be taken with some urgency it was decided to change the location of EMC 2012 to this new venue in Manchester. More information on the complex can be found at *www.manchestercentral.co.uk*.

In 2010 the EMS membership stabilized at around 5450 members, with 42 corporate members. All national or regional microscopy societies in Europe now offer their members parallel membership of EMS, usually for free, which ensures a large coverage for all our electronic communications as well as this Yearbook.

We continue to see remarkable developments across Europe in microscopy hardware and software despite the increasingly precarious economic situation. We realise that tough times may lie ahead for many microscopists and microscopy companies and the EMS will continue to support and assist its members, especially its more junior members, in all the ways we can. We look forward to a number of key microscopy conferences, in Europe and elsewhere, over the next 12 months and wish all our members a highly successful and rewarding 2011.

Yours sincerely,

Paul Midgley
President EMS



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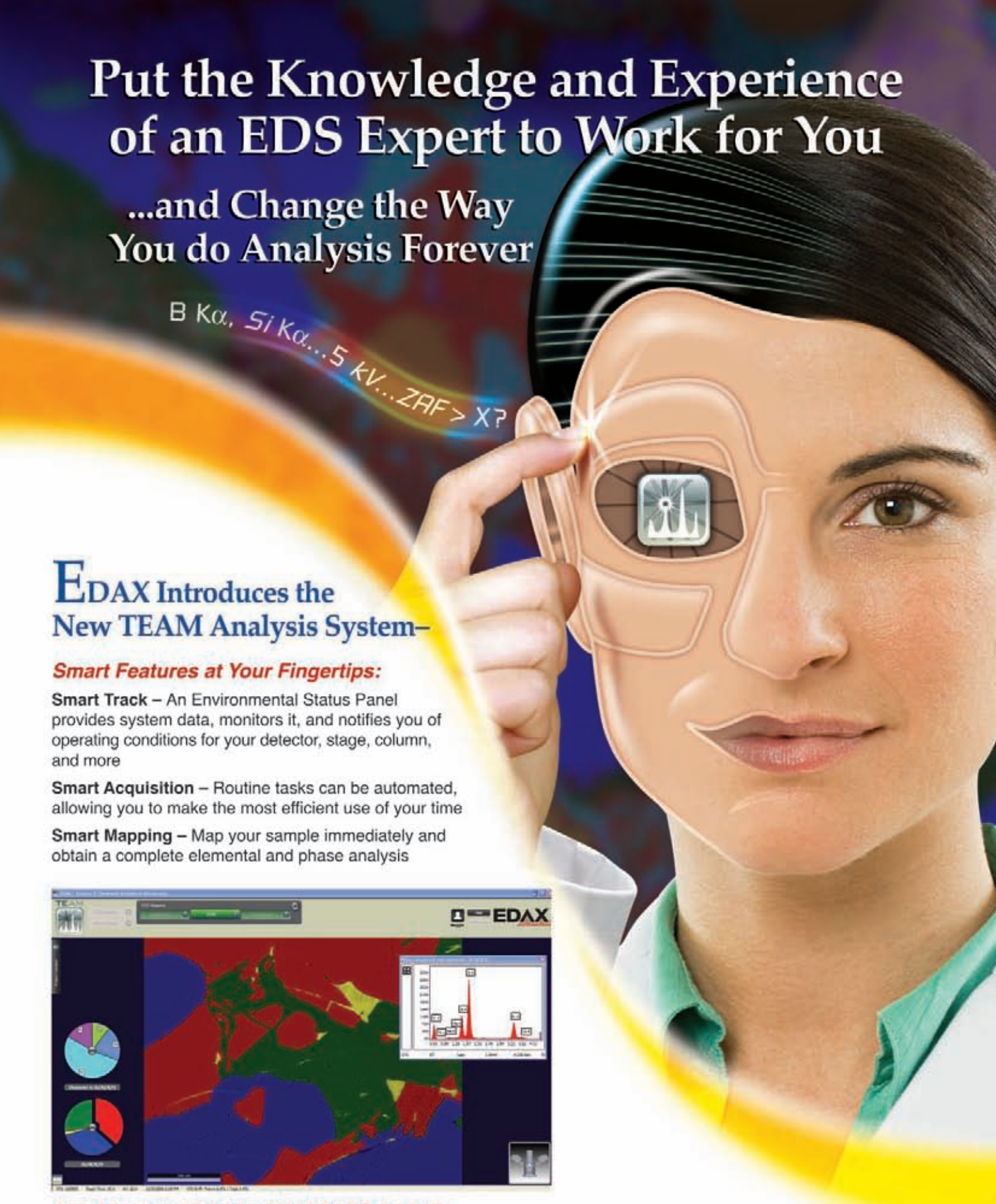

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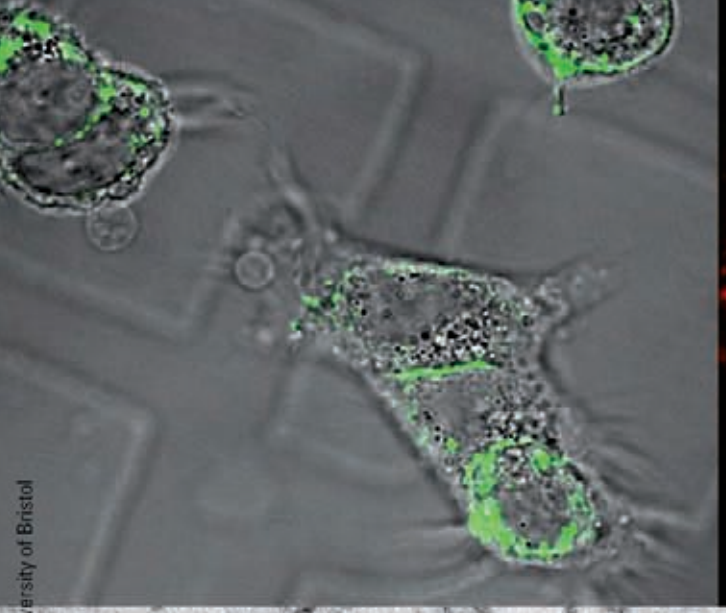

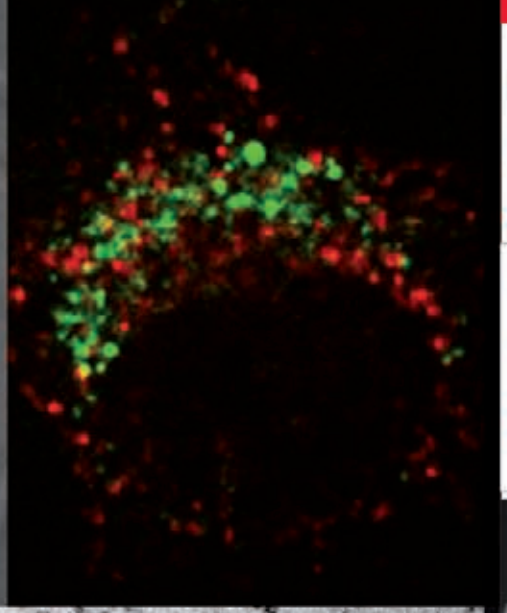

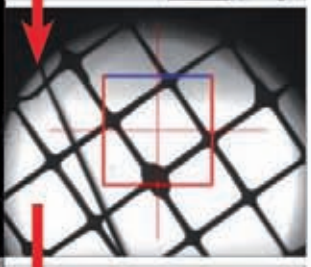

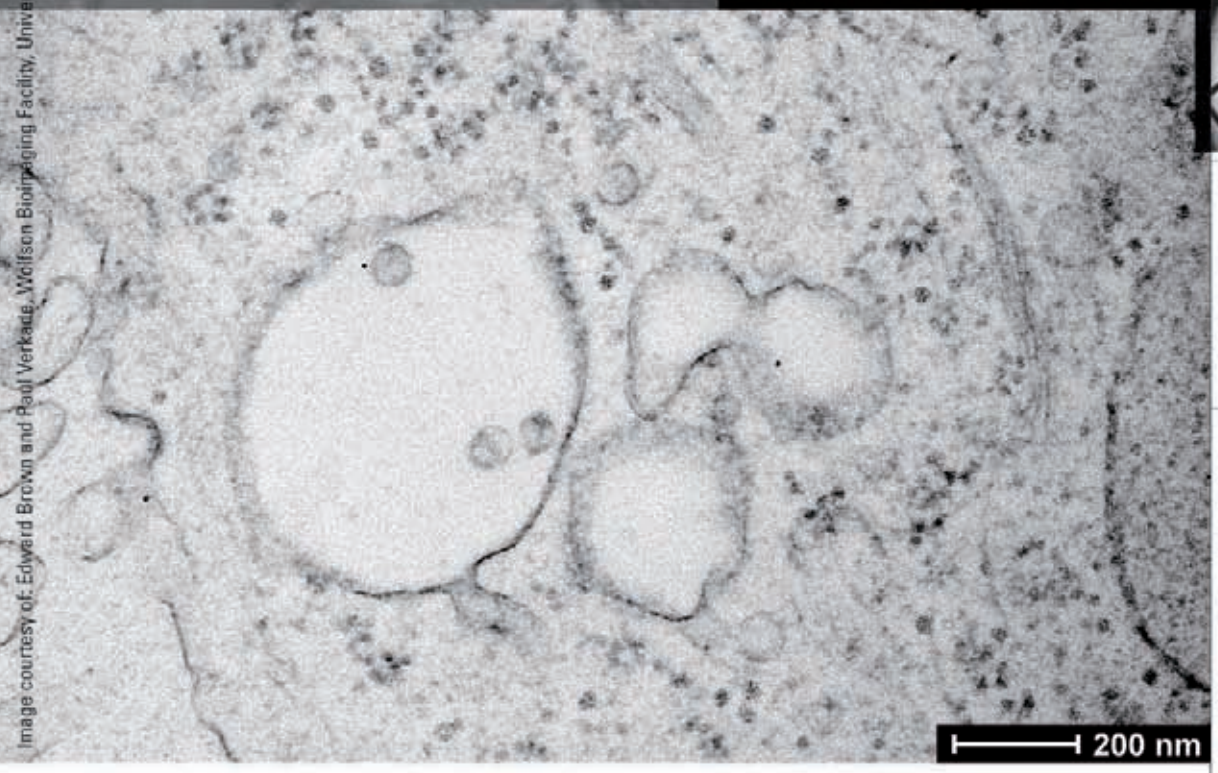

Image courtesy of: Edward Brown and Paul Verkade, Wolfson Bioimaging Facility, University of Bristol

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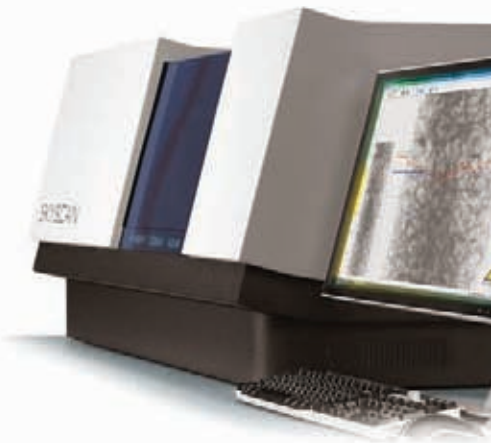

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REPORT ON EMS EXTENSIONS

Notes :

MICROSCIENCE 2010

MICROSCIENCE 2010,

London ExCeL Centre 28 June-1 July 2010 building for EMC 2012

MICROSCIENCE 2010, the Royal Microscopical Society's flagship meeting held at ExCeL London at the end of June, attracted 519 conference delegates - the first time that the 500-barrier has been broken. And, the overall visitor-target of 2,000 was also reached.

Some of this growth may be attributable to the event being an EMS Extension Meeting, with over 30% of delegates coming from outside the UK – from 5 continents and 30 countries.

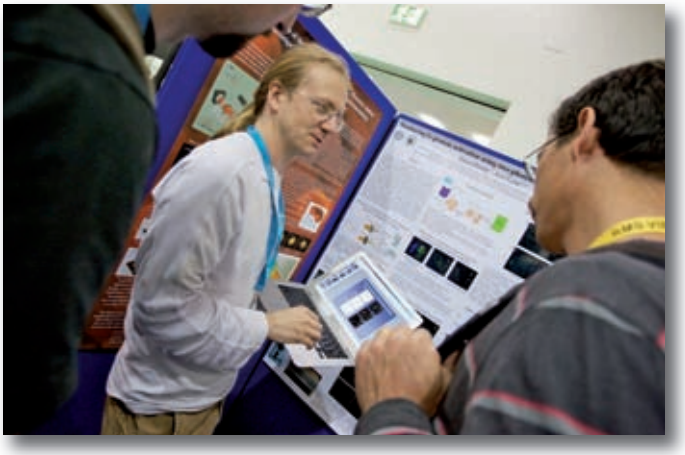
The international conference featured three parallel themes containing eighteen symposia devoted to Life, Materials, and New Frontiers. They struck a balance between biological and physical sciences, and light, electron and other microscopies. In addition, the annual UK Scanning Probe Microscopy meeting was also held. This breadth made **MICRO**SCIENCE 2010 the Society's most inclusive event yet.

"In 2008 and 2010 we focused on developing the scientific-standing of the conference, and it has really paid off," says Dr Debbie Stokes, Co-Chair of the Organising Committee. "The tone and quality was set each day by the Plenary Speakers - Dr Jennifer Lippincott-Schwartz, Professor Sir John Meurig Thomas, and Professor Wolfgang Baumeister. The standard of the science throughout has been very high, and the first feedback from delegates has been extremely positive.

Professor Sir John Meurig Thomas

The RMS is most grateful to the EMS for sponsoring Professor Sir John Meurig Thomas and Professor Baumeister whose Plenary Talks were so well attended.

Another benefit of **MICRO**SCIENCE 2010 being an EMS Extension Meeting was that it welcomed members of the EMS General Assembly for their meeting which was chaired by Dr Nick Schryvers, the Secretary of the EMS. An important item on the agenda was a report from Dr Stokes, who is Chair of the EMC 2012 Organising Committee. She was able to give delegates a clear view of how the event is taking shape, and how the expertise of the EMS-membership will be used in the coming months to influence and set the Scientific Programme.



The science that was presented at **MICRO**SCIENCE 2010 was of the highest standard, and it was matched by Europe's largest exhibition dedicated to microscopy and imaging. A record 1,170m^2 of space was taken by 99 companies. The quality of the stands, and the range and value of equipment on show was quite breathtaking. Rod Shipley of FEI, who is Vice-chair of the RMS Corporate Advisory Board, summed it up succinctly; "**MICRO**SCIENCE continues to be the best commercial exhibition in Europe."

However, the success of the exhibition does not rely on visitor-numbers alone. The companies need to see a return on investment. And, the first signs are good.

«It's been a very worthwhile event,» says Huw Thomas of Leica Microsystems UK, and Chair of the RMS Corporate Advisory Board. «The visitor numbers have been good and the team on the stand have been busy the whole time. What's most encouraging is that we have met with a number of new groups and we can look forward to developing relationships with them in the future.»

The international conference and exhibition were the heart of the event, but there were other popular features. The Learning Zone was full with contemporary equipment, generously loaned by exhibitors. There was a range of light microscopes, two confocal, and three electron microscopes. These gave visitors valuable hands-on experience and the

opportunity to talk with expert-volunteers about the challenges they face in their professional lives. And, visitors could also question the manufacturers about their products via the programme of technical workshops that ran throughout the event.

When you add all of these components to a full and vibrant social programme, it is easy to see why the **MICRO**SCIENCE series continues to grow. The features that work well are refined and carried forward, and new items are introduced as part of a constant programme of impro-vement by the RMS. This experience and continuity will be used in the planning of the European Microscopy Congress which the RMS and its UK counterparts will host in Manchester in 2012.

EMC 2012 will be twice the size of **MICRO**SCIENCE 2010, with a minimum of six parallel themes. Feedback on plans for the exhibition has been very positive.

"We attended Aachen in 2008 and were able to see the conference and exhibition at first hand," says Allison Winton, the RMS Event Director. "Since then we have maintained a dialogue with exhibitors and many have indicated the size of stand they are looking for in two years time. Some are looking to have a very big presence. It's very exciting."

The scientific quality of the conference is the overriding driver for the event. This is what attracts delegates and exhibitors, and the early support of the companies and the EMS General Assembly is a sign that the plans are heading in the right direction.

So, the aim is to build on the successes of previous Congress, and to stage the largest and best microscopy and imaging event ever seen in Europe. It will be even more inclusive, bringing together researchers, practitioners, and companies in new and novel ways - and, not just those from Europe, but from Asia, Africa, Australasia, and the Americas.

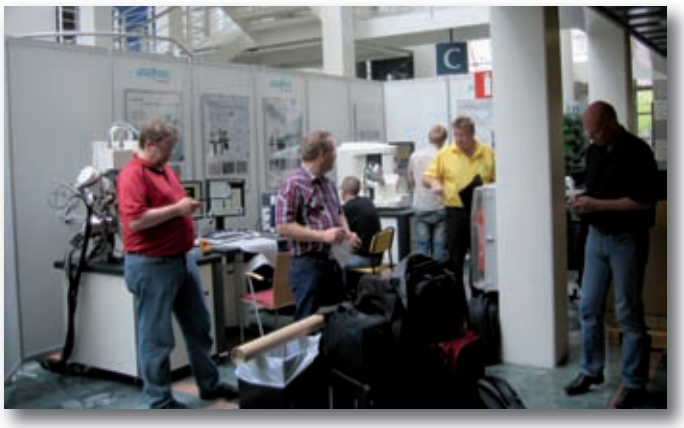
"This year the RMS put together a super wide-ranging conference on almost all aspects of microscopy, together with one of the best exhibitions you are likely to see," says Professor Tony Wilson, newly elected President of the RMS, and Vice-chair of the EMC Organising Committee. "In 2012 we are being more ambitious and planning something even better, and I would encourage anybody with a passion for microscopy and imaging to put the date in their diary." The European Microscopy Congress 2012 will be 16th – 21st September 2012. The First Call for Papers will be made on 1st October 2011.

For further details, www.emc2012.org.

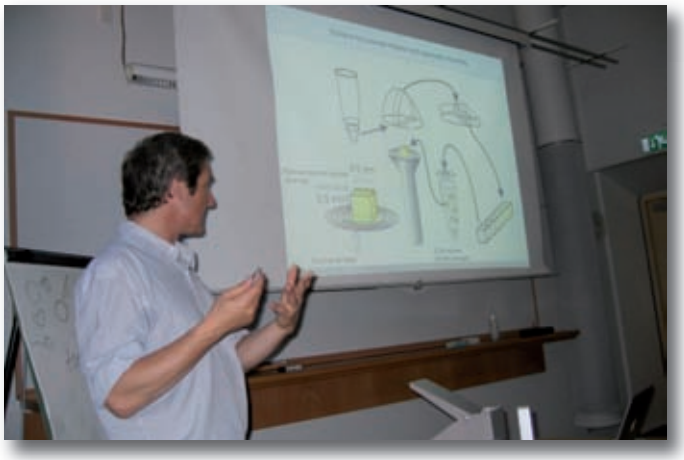
SCANDEM 2010

June 8-10, Kista KTH Electrum, Stockholm, Sweden

The Annual Scandem Meeting was held in Stockholm at the Conference Center of the Royal Institute of Technology, Kista Forum on 8-10th of June. This year it was a joint SCANDEM and EMS Extension. Six different workshops preceded the meeting, which were organized at Royal Institute of Technology, Karolinska Institutet, and Stockholm University. These workshops included discussion and training sessions in combined SEM and FIB techniques, scanning probe microscopy; FE-SEM and TEM, immuno-EM and cryo-EM, and computational TEM: tomography, single particle analysis, 2D crystallography.
As usual, the annual SCANDEM event united scientists and students working in different fields and people from industry, that created a special atmosphere during discussions following plenary lectures, during poster sessions and exhibitions, at which a broad spectrum of questions have been asked. Lectures at the Meeting were given by leading specialists from Europe, USA, Japan, and Australia.



EMS sponsored lectures were given by Drs. Niels de Jonge from the Department of Molecular Physiology and Biophysics, Vanderbilt University Medical Center, USA and Martin Hýtch from CEMES-CNRS, Université de Toulouse, France.
The focus of the meeting was on high-resolution microscopy. Contrary to previous meetings, however, not only transmission and scanning electron microscopy approaches were discussed. Several lectures and presentation were devoted to recent developments in the field of scanning probe microscopy and combinations of different techniques as well as correlative LM and EM methods.

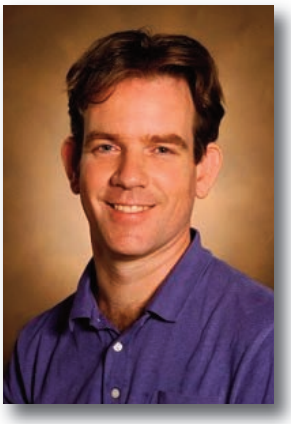


More than 40 posters were presented at the Meeting. Two of the students Paula Upla (University of Jyväskylä, Finland) and Justinas Palisaitis (University of Linköping, Sweden) received prices for "the best poster presentation".
Prof. Osamu Terasaki from Stockholm University, Sweden and Graduate School of EEWS (WCU), Korea was unanimously elected as a new honorary member of SCANDEM.
Scandem 2010 was certainly a success. The organizers would like to express special thanks to the Swedish Research Council, Wenner-Gren Foundation, Linné Center of Excellence DBRM and Nordic Imaging Network (NORFA), for the support, which allowed to invite outstanding speakers. We are also grateful to several companies such as FEI, JEOL, TVIPS, Diatome, Leica and Atomic Force for sponsorship of the event and excellent lectures. We also thank all companies, which participated in exhibitions and displayed their recent products. More details about SCANDEM2010 and conference proceedings can be found at www.scandem.org. On behalf of the Organizing Committee, Prof. Oleg Shupliakov.

From left to right: Malin Torsæter (PhD student, NTNU,Trondheim, Norway), Randi Holmestad (Professor, NTNU, Trondheim, Norway), Tatsuo Sato (Professor, Tokyo Tech, Japan), Kenji Matsuda Professor, Toyama University, Japan).

EMS lecture at SCANDEM 2010

By Niels de Jonge
Molecular Physiology and Biophysics,
Vanderbilt University Medical Center, 2215 Garland Ave,
Nashville TN 37232-0615, USA.
Email: niels.de.jonge@vanderbilt.edu
URL: http://www.mc.vanderbilt.edu/labs/dejongelab/



Imaging Tagged Protein Labels in Eukaryotic Cells in Liquid with STEM

Introduction

Since the early days of electron microscopy it has been a goal to achieve nanometer resolution on cells in liquid (Parsons, 1974).

Two technological achievements from the last decade, the introduction of nanoparticles as specific protein labels (Xiao, et al., 2003) and the development of silicon nitride membranes for use as electron-transparent windows in a liquid compartment (Williamson, et al., 2003), have led to the introduction of a novel concept to achieve nanometer resolution on tagged proteins in cells (de Jonge, et al., 2009). Eukaryotic cells in liquid are placed in a micro-fluidic chamber with a thickness of up to 10 mm contained between two ultra-thin and electron-transparent windows, see Figure 1.

The specimen is then imaged with the scanning transmission electron microscope (STEM). On account of the atomic number (Z) contrast of the STEM (Crewe, et al., 1970; Engel, 2009), nanoparticles of a high-Z material, such as gold, can be detected within the background signal produced by a low-Z liquid, such as water.

The nanoparticles specifically attached to proteins (Xiao, et al., 2003) can then be used to study protein distributions in whole cells in liquid, similar as proteins tagged with fluorescent labels can be used to study protein distributions in cells with fluorescence microscopy (Lippincott-Schwartz, et al., 2001), but then with a factor of 50 better resolution.

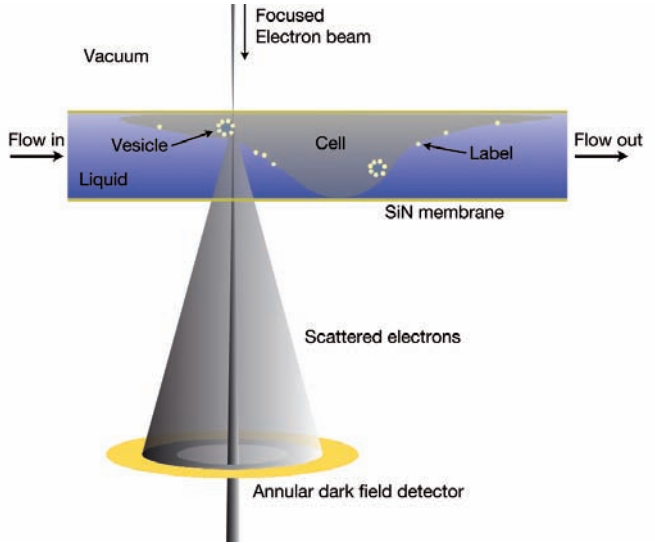


Figure 1: The principle of liquid scanning transmission electron microscopy (STEM). Cells fully embedded in liquid are enclosed between two electron-transparent silicon nitride windows. Images are obtained by scanning a focused electron beam over the sample and detecting the elastically scattered electrons with an annular dark field detector. Labels made of a high atomic number material can be distinguished with nanometer resolution. From (de Jonge, et al., 2009).

Theory

The contrast of liquid STEM images is dominated by elastic scattering of the electrons in the specimen and detected with the annular dark-field (ADF) detector. The number of electrons N scattered into an ADF detector with semi-angle β is calculated from the partial cross section for elastic scattering $\sigma(\beta)$ as (Reimer, 1984):

$$\frac{N}{N_0} = 1 - \exp\left(-\frac{T}{l(\beta)}\right), l(\beta) = \frac{W}{z\sigma(\beta)\rho N_A} \quad (1)$$

with N_0 the number of incident electrons, mean-free-path length for elastic scattering l, mass density ρ, atomic weight W and Avogadro's number N_A,. When imaging a nanoparticle of diameter d in the top layer of the liquid, the contrast is formed from the signal difference between a pixel recorded at the position of the nanoparticle, and a pixel in which the electron beam interacts with the liquid only. It was found that the minimum detectable particle size δx equals (de Jonge, et al., 2009):

$$\delta x = 5 l_{gold} \sqrt{\frac{2T}{N_0 l_{water}}} \quad (2)$$

Typical experimental conditions are $6x10^4$ electrons per pixel, $\beta = 70$ mrad, beam energy $U = 200$ kV, $l_{gold} = 73$ nm, and $l_{water} = 10.5$ μm, such that $\delta x = 1.5$ nm for $T = 5$ μm. Experiments with test samples showed that 1.4 nm diameter gold nanoparticles could be resolved on a water layer with $T = 3$ μm (de Jonge, et al., 2010).

Results

The liquid STEM system contains a microfluidic chamber assembled from two silicon microchips, each supporting a 50 nm thick silicon nitride (SiN) window (Protochips, Inc., NC, USA) (Ring & de Jonge, 2010). Figure 2A shows a scanning electron microscopy (SEM) image of the backside of a microchip. The dimensions of the microchip were 2.00 × 2.60 × 0.30 mm, and those of the SiN window were 50 × 200 μm. Two microchips were placed in the tip of a specimen holder for liquid flow (Protochips Inc., NC), see Figure 2B. The interior of the microfluidic chamber was sealed from the vacuum of the electron microscope, and connected to a syringe pump (Harvard Scientific, MA), which was outside of the electron microscope. One of the microchips contained a spacer, typically 6 μm thick, such that liquid could flow between the microchips, and to provide a specimen chamber with sufficient height to contain thin eukaryotic cells.

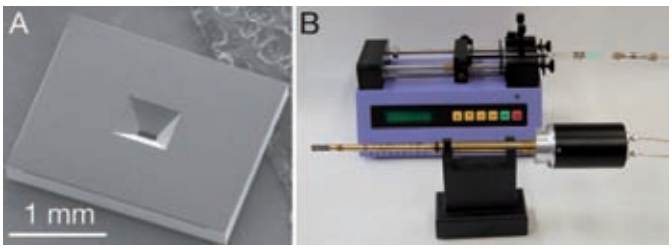


Figure 2: The key components of the liquid STEM system. (A) Scanning electron microscopy image showing the backside of a microchip with a silicon nitride window in the middle. (B) Photograph of the liquid STEM specimen holder including a syringe pump. Plastic tubing connects the liquid in the syringe with the microfluidic chamber at the tip of the specimen holder, which is placed in the vacuum chamber of the electron microscope.

In the initial work (de Jonge, et al., 2009), COS7 fibroblast cells were labeled with gold nanoparticles conjugated with epidermal growth factor (EGF). Whole glutaraldehyde fixed cells in liquid were imaged with STEM at 200 kV with a spatial resolution of 4 nm, while providing imaging at 20 μs pixel dwell time. The electron dose used for one image was $7x10^4$ e-/nm^2. Figure 3A shows the edge of a cell that was incubated for 5 minutes with EGF-Au. Gold labels can be recognized as yellow spots on the blue background. The cellular material has light-blue color. The localization of the labels at the cell edges after 5 minutes of label incubation is consistent with the physiological distribution of the EGF receptor, which is randomly dispersed over the cell surface (Lidke, et al., 2004). To observe molecular rearrangements of the EGF receptors in the COS7 cells after ligand binding, a second batch of cells was incubated for 10 minutes with EGF-Au, then washed and incubated for an additional 15-minutes period in buffer. Liquid STEM images of these cells are shown in Figure 3B. Circular clusters of labels are visible, which were interpreted as the clustering of the EGF receptor in internalized endosomes after receptor activation (Lidke, et al., 2004).

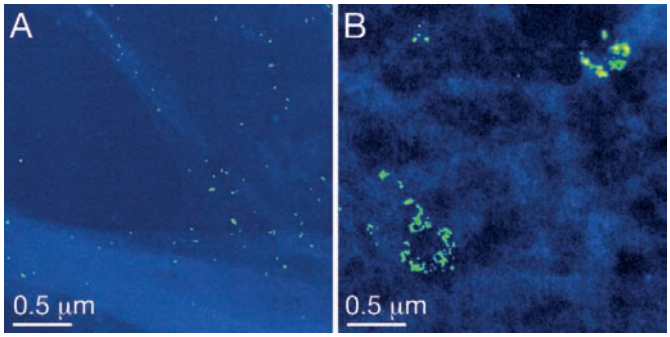


Figure 3: Liquid STEM images of gold-labeled epidermal growth factor (EGF) receptors on COS7 fibroblast cells. (A) Image of the edge of a fixed COS7 cell after 5 minutes incubation with EGF-Au. The gold labels are visible as bright yellow spots on the blue background. The background shows some detail of the edge of the cell. (B) Image of a COS7 cell incubated with EGF-Au for 10 minutes, then incubated in buffer for an additional 15 minutes. Color coding based on grey level of the original images. Images modified from (de Jonge, et al., 2009).

Liquid STEM can also be used in combination with bimodal probes, which are visible with both fluorescence and electron microscopy, such as dye-conjugated gold nanoparticles or semi-conductor nanocrystals known as quantum dots (QDs) (Gaietta, et al., 2002). COS7 grown on microchips were incubated for five minutes with EGF conjugated to QD (EGF-QD), and then fixed with glutaraldehyde (Dukes, et al., 2010). The microchips with cells were first imaged by fluorescence microscopy. Figure 4A shows a section of a window partly covered with cells. The QD labels light up as bright spots on the cells against the dark background of cell-free regions. The microchips with cells were then assembled into the microfluidic chambers for liquid STEM imaging. Figure 4B shows a liquid STEM image recorded of the same cell as shown in Figure 4A. The lower two-thirds of the image contain bright spots of similar sizes, which we associate with the presence of QDs. Some debris left over from the microchip fabrication process is visible as well. The QD-labeled EGF receptors are distributed

almost evenly over the surface of the cell, consistent with the well-characterized behavior of the EGF receptor (Lidke, et al., 2004). The located at the edge of the cell is consistent with the localization of QD regions on the cells in the fluorescence image in the square of Figure 4A.

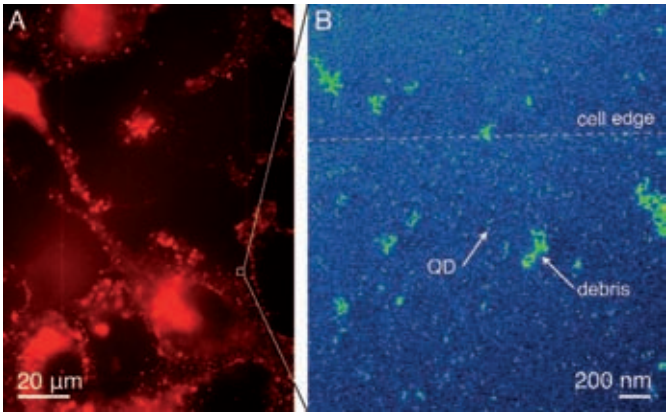


Figure 4: Correlative light microscopy and liquid STEM of intact fixed eukaryotic cells in saline water. (A) Red fluorescence signals from COS7 cells with QD-labeled EGF receptors. Some unspecific fluorescence from the fixative is also visible. The rectangular shape outlines the silicon nitride window. (B) Liquid STEM image of the region indicated with a square in (A). Individual QDs along the edge of the cell can be discerned as yellow spots on a blue background. Some debris is also visible. The magnification was M = 48,000. The signal intensity was color-coded to increase the visibility of the labels. Figure modified from (Dukes, et al., 2010).

Conclusions and outlook

Liquid STEM provides a spatial resolution of 4 nm and better on specific protein labels. Correlative fluorescence microscopy and liquid STEM is possible via the use of QD labels. The sample preparation is compatible with light microscopy, thus avoiding preparation of the cells into conventional thin sections, or cryo sections. Liquid STEM can be used to image cellular organelles, and molecular configurations of, for example, multiple proteins and ligands in whole eukaryotic cells in liquid. One could bring a cell in a certain functional state, defined by a specific molecular configuration of protein complexes and bound ligands, and study the cell with fluorescence imaging. At a certain time point of interest, one could then record correlative liquid STEM images of the labels to investigate protein distribution at the nanometer level. By repeating the experiment for cells in different states, liquid STEM could be used to study cellular function at the level of protein complexes via a direct method. The combination of nanometer resolution and much of the functionality of fluorescence microscopy will be significant for many fields of biomedical research.

Acknowledgements

I would like to thank many people who contributed to this research and especially, Diana B. Peckys, Dominique Drouin, Madeline J. Dukes, Elizabeth A. Ring, and David W. Piston. The liquid STEM system was provided by Protochips Inc. A Portion of this research was conducted at the SHaRE User Facility, which is sponsored by the Division of Scientific User Facilities, Office of Basic Energy Sciences, U.S. Department of Energy. Research supported by Vanderbilt University Medical Center, NIH grant R01GM081801, and NIH grant 1R43EB008589.

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EMS LECTURE AT MICROSCIENCE 2010

By Wolfgang Baumeister
Max-Planck-Institute of Biochemistry, Am Klopferspitz 18, 82152 Martinsried, Germany

In-situ Structural Biology by Cryoelectron Tomography

Introduction

Electron tomography enables the three-dimensional visualization of large and stochastically variable (i.e. non-repetitive) structures ranging from supramolecular assemblies to organelles or even entire cells. In conjunction with cryogenic techniques electron tomography avoids the artifacts that are notorious to conventional electron microscopy specimen preparation involving chemical fixation, heavy metal staining and dehydration. At resolutions of a few (2-4) nanometers it provides unprecedented insights into the molecular organization of cellular landscapes and it has the potential to bridge the divide between molecular and cellular structural studies. It allows the visualization of molecular machines in their functional environment, the cell. This is particularly important for the structural characterization of molecular machines and supramolecular assemblies present in low copy numbers or rooted so deeply inside cells that it is impossible to isolate them by cell fractionation techniques without violation of their structural integrity[(I)].

Principles and limitations of electron tomography

Electron tomography, like other tomographic imaging modalities, relies on the principle of recording images from different viewing angles, aligning the resulting projections to a common coordinate system and combining them computationally to form a three-dimensional image. The practical realization of cryoelectron tomography had to reconcile two requirements which are obviously in conflict with each other: detailed reconstructions with minimal distortions require a large number of images covering as wide an angular range as possible. On the other hand the radiation sensitivity of biological materials embedded in ice necessitates a minimization of the cumulative electron dose. The allowable total dose, i.e. the dose not causing any visible damage has to be fractionated over a maximum number of projections with the aid of automated data acquisition methods. Furthermore, microscope control software incorporates the compensation of image shifts and focus changes resulting from the imperfect eucentricity of the tilting devices. The signal of the individual projection images must be sufficient for the precise tracking of the specimen during the acquisition of the data set and, afterwards, the alignment of the projections.

The theoretical resolution, d, of a tomographic reconstruction from a cylindrical volume of diameter, D, generated from N equally spaced projections covering the full angular tilt range of ±90° can be described broadly by the relationship $d \sim \pi D/N$[(II)]. Yet, the concept of resolution in electron tomography is not trivial and it is meaningless if one does not consider structural preservation. In addition to the limited number of projections, specimen geometry typically restricts the angular range to ±70°. According to the projection theorem, the non-sampled region (here, ±20°), defines a 'missing wedge' in reciprocal space. The consequence is anisotropic resolution, giving rise to distortions in the reconstructed volume. More elaborate tilt geometries fill some of the missing wedge and, in the case of dual-axis tilting about orthogonal axes, the wedge is reduced to a 'pyramid' and the resolution becomes more isotropic. For a tilt range of ±45°, a single-axis tilt scheme samples only 50% of the information, whereas dual-axis tilting over this range samples 67% of the information. For the more optimistic tilt range of ±70°, the sampling completeness rises from 78% (single-axis) to 93% (dual-axis). The 'slab' geometry typical of vitreous thin films results in a progressive increase in sample thickness at higher tilt angles: for a specimen with uniform thickness of 200 nm, tilting to 70° results in an effective path length of almost 600 nm. The mean free path for 300 keV electrons in ice is ~350 nm, implying that with longer path lengths multiple inelastic scattering will occur. The resultant blurring

and degradation in image contrast can be alleviated with an energy filter operating in 'zero-loss' mode[III].

Molecular interpretation of tomograms

Cryoelectron tomograms of organelles and cells contain vast amounts of information that extends beyond cellular ultrastructure. Essentially, they are three-dimensional representations of the entire proteome and they are snapshots of the interaction networks underlying cellular functions. However, the retrieval of this information is not a trivial task because the signal-to-noise ratio of the tomograms is low and individual macromolecules are difficult to recognize in an environment that is so crowded that they literally touch each other. Even the segmentation of structural features such as actin filaments or microtubules requires sophisticated image processing ('denoising') and image analysis tools.

There are two alternative (albeit not mutually exclusive) approaches for the identification and mapping of macromolecules in cellular environments, namely the specific labeling[IV] with electron dense markers and computational strategies based on innate structural signatures and pattern recognition[V]. Strategies based upon labeling cannot detect more than a tiny fraction of the proteome simultaneously in any given sample. Computational methods allow, at least in principle, to interrogate and interpret tomograms in a comprehensive manner [VI]. However, methods based on pattern recognition are more demanding in terms of resolution and they require some a priori knowledge of the macromolecular under scrutiny. Here the task is to identify and locate known structures (templates) in a cellular tomogram by some form of cross correlation. This approach has been used with great success to characterize multiple supramolecular configurations of ribosomes (polysomes, 100S 'hibernating' ribosomes) in their cellular habitats[VII,VIII].

Correlative imaging with spatial and temporal resolution

The judicious use of multiple imaging techniques can provide complementary information concerning cell structure and function. These techniques should not only span several orders of magnitude in spatial resolution but they should also enable one to monitor cellular processes and capture them at crucial points in time[IX]. Vitrification provides a 'snapshot' with a temporal resolution in the range of milliseconds. An integrated approach must, therefore, be developed to observe specific cellular structures and processes in real time, using live cell imaging techniques, to subsequently immobilize such events without delay by vitrification and to acquire high-resolution information from precisely preselected sites. Recently, cryofluorescence microscopy has been developed as an adjunct to cryoelectron tomography. Fluorescence microscopy can thus be exploited to navigate the cellular landscape under cryogenic conditions and to identify features of interest before zooming in on the area and take a tomogram. The fluorescence signal offers an independent and unambiguous confirmation of the identity of the feature and it provides an alternative to the tedious search for structures present in low copy numbers[X].

Overcoming the specimen thickness problem

A critical limitation in cryoelectron tomography is specimen thickness which should not exceed 0.5 to 1 mm. Only prokaryotic cells or thin regions or appendages of eukaryotic cells are thin enough to be investigated in their entirety. Larger cells or tissues must be sectioned prior to their examination in the EM. Cryosectioning maintaining the vitreous state of the sample is not only technically demanding, it is also marred by artifacts. Mechanically generated slices of ice-embedded cells inevitably suffer from distortions such as compressions or 'crevasses'. An alternative to cryosectioning is the emerging use of focused ion-beam (FIB) technology ablating the surface of a frozen-hydrated sample until the thickness is suitable for electron tomography. First results obtained with this method are encouraging but more in-depth studies are needed to confirm that exposure to the ion beam does not cause damage beyond the uppermost regions of the sample. The targeted ablation of material makes it necessary to embed the FIB treatment into a workflow allowing to identify and select regions of interest for thinning, e.g. by fluorescence microscopy.

Outlook

It is reasonable to expect that advances in instrumentation and methodology will enable us to reach resolutions of 2nm or even better in cellular tomography as will be needed for a comprehensive characterization of supramolecular architecture inside cells. For making cryoelectron tomography applicable to a wide range of eukaryotic cells we must further

develop techniques for the targeted micromachining of frozen-hydrated samples. Correlative microscopy at cryogenic temperatures will be indispensible for the navigation of large cellular landscapes. More sophisticated software tools for the classification and averaging of subtomograms will provide us with increasingly detailed pictures of molecular structures captured in action in their functional habitat. Structural biology is entering the post-reductionist era and there is no doubt that cryoelectron tomography will become a key player in integrative structural studies.

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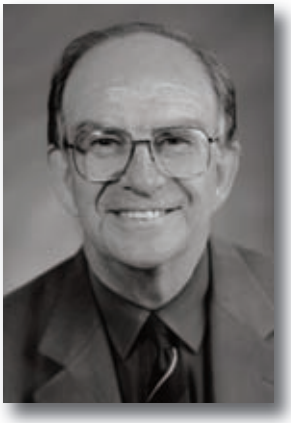
EMS LECTURE AT MICROSCIENCE 2010

By Sir John Meurig Thomas
Department of Materials Science, University of Cambridge, Cambridge, CB2 3QZ, England



The Genius of Michael Faraday: A Summary[1]

Lord Rutherford said of Michael Faraday (1791-1867) that he was one of the greatest experimenters ever. Albert Einstein believed that Faraday was responsible for the greatest change in the intellectual framework of physical sciences since Newton. There is little doubt that Faraday bequeathed a larger corpus of useful knowledge than any other physical scientist.

Figure 1: Humphry Davy at the age of 40.

This talk outlines how it came about that Faraday, a deeply religious man, who left school at thirteen to become an errand boy and then an apprentice to a bookbinder – a young man who never attended high school or a university and knew no mathematics – could reach such pinnacles.

It all began in earnest for the 21-year-old when he was given tickets to attend the last four lectures by Sir Humphry Davy (Figure 1) at the Royal Institution (RI) of Great Britain in Albemarle Street, London in March 1812. Davy remained associated with the RI until his death in 1829, but was no longer Director. From the early 1820s onwards that role was taken over by Faraday, whom Davy appointed first as bottle-washer, then as assistant, after interviewing him in March 1813.

The full trajectory of Faraday's career, encompassing his journeys through France, Italy, Austria and Switzerland with Sir Humphry and Lady Davy (from October 1813 to May 1815) is told in a short monograph that I wrote to celebrate the bicentenary of Faraday's birth – see reference[2]. Faraday's career as a natural philosopher ascended rectilinearly to stratospheric altitudes on returning to the RI. He liquefied, for the first time, over a dozen gases (including ammonia, the basis of early and later refrigeration), he discovered and established the chemical formula of benzene which he prepared by the distillation of fish oil. He invented the first electric motor in 1821. He pioneered organic photochemistry. He became a superb analytical chemist (and could have accumulated substantial riches if he had continued to serve as expert witness in legal disputes). He identified isomers of chemical compounds. He improved the optical quality of glass and it was he who first drew glass fibres of the kind that later were utilised as light guides. He pioneered the study of dielectrics – such was the magnitude of his contribution to this field that the unit of capacitance is named a Farad in his honour. In 1829 he wrote a masterly text (646 pages) on Chemical Manipulation.

He studied heterogeneous catalysis, colloidal metals and ionic conductivity in inorganic solids such as PbF2, during which he was the first to note the now topical subject of superionic conductivity. He also identified the phenomenon of semiconductivity and what is now termed thermistor action (well over a century before it became the centrepiece of electrical and electronic circuitry).

The prodigality of his output was Haydnesque. It is arguable that he left a greater corpus of scientific discoveries than any other scientist, before or since. Lord Rutherford in 1931 called him the greatest scientific discoverer ever, and his successor as director of the Royal Institution, John Tyndall, set out in a series of Discourses in 1868, later published as a book, the astonishing chronicle of *Faraday as a Discoverer*.

Arguably, Faraday's greatest single discovery was that of electromagnetic induction. But before we pursue that momentous breakthrough we should note his work on the notion of lines of force. He argued that a magnetic field surrounded a magnet just as he later argued that a gravitational field surrounds every solid object. In fact, Faraday was the founder of field theory, all theoreticians and cosmologists ever since have acknowledged the fact. Faraday, in his mind's eye, could picture lines of force emanating from a magnet, and he illustrated the reality of this picture by sprinkling iron filings on a paper beneath which he placed a magnet. His lines of force ushered a new era into physics and cosmology; an era built on the concept of field, which pervades the space around a magnet and around an electric current, and, in the words of James Clerk Maxwell (much later) "weaves a web through the sky".

In electromagnetic induction, an electric current is produced in a wire coil if a bar magnet is inserted into or withdrawn from the axis of that coil. With this discovery, Faraday also invented the dynamo and transformer action.

Newton showed that terrestrial mechanics and celestial mechanics are synonymous. The paths of celestial bodies like planets, comets and space vehicles as well as the precise times of sunrise and sunset may be computed via Newton's laws. So may the ebb and flow of the tides on all the shores of the oceans of the earth. But Newton's laws and Newton's physics do not help us one iota in accounting for the transmission and reception of radiowaves, for the operation of the fax machine, for wireless telegraphy, television or digital video display (DVD), or for the functioning of cellular phones – nor do they explain how, in the modern electronic age, we may, if we wish, be suffused with the magic of Schubertian music or the lyricism of the Kreutzer sonata. All of these may be traced back, step by step, to the experimental discoveries of Michael Faraday and the theoretical work of Clerk Maxwell.

In 1845, Faraday made his historic discovery that the plane of polarisation of a beam of light, on passing through a slab of glass, could be rotated by the application of a magnetic field. This experiment proved that every beam of light has a minute magnetic – and also a minute electrical – component. This is the so called Faraday effect in magneto-optics. (With its aid, one may nowadays construct ultra-fast switches in electronic circuitry involving light beams).

A few weeks after he made this discovery, he despatched to the Royal Society a paper entitled "*On the Magnetisation of Light and the Illumination of Magnetic Lines of Force*" which began with a sentence of Chekhovian timelessness: "I have long held an opinion, almost amounting to conviction, in common, I believe, with many other lovers of natural knowledge, that the various forms under which the forces of matter are made manifest have one common origin; or, in other words, are so directly related and mutually dependent, that they are convertible, as it were, one into another, and possess equivalents of power in their action…".

Here is a reflection of his religious convection. He read the book of Nature written by the finger of God, alongside the direct word of God, the Bible. I mentioned earlier that Faraday could legitimately be regarded as the father of electro-chemistry. The laws of electrolysis discovered by him in 1833 are among the most accurate in the whole of the physical sciences, and they enable the unit of change to be quantitatively defined. The principle of electro-magnetic induction, which he discovered in 1831, prompted him shortly thereafter to enquire whether – and indeed to demonstrate that – all the various forms of electricity, irrespective of their mode of generation (by induction, by a Voltaic pile, via "Franklinic friction", or by an electric eel) are identical. The quantity of electricity required to liberate one gram equivalent in electrolysis is known as the Faraday. No other scientist has two fundamental units named after him.

Magneto-chemistry is another major subject discovered by him in 1845. He had earlier built the most powerful magnet in the world; he soon found out that apart from ferromagnetism (exhibited by iron and cobalt), all substances are either attracted into, or are repelled by, a magnetic field. In a frenetic two-month period, Faraday tested the magnetic properties of all the chemicals and materials that he could lay his hands on – not just iron but bismuth, iodine, lead,

wood, meat, vegetables and gases such as nitrogen and oxygen. He found that nitrogen was repelled by a magnet, whereas oxygen was attracted. The former is said to be diamagnetic and the latter paramagnetic, two terms coined by Faraday. Faraday also reported the paramagnetism of haemoglobin.

In 1836 Faraday carried out his famous "cage" experiment, when he built a 12' x 12' x 12' metallic structure covered in fine (conducting) wire mesh, one side of which had a door through which he could step inside. With the cage insulated from earth, it was charged, via an external machine (a forerunner of the Wimshurst machine), to a potential of approximately 150,000 volts. This caused large sparks and flashes, like artificial lightning, at the outside of the cage. But Faraday, holding a sensitive electrometer, was unperturbed and unaffected by this fierce electrical activity. This demonstrated, in a daring fashion, that an electrified body carries its charge on the outside surface, a fact that is salutary and reassuring to remember when we fly as passengers in a jet aircraft through storms and lightning.

In 1826, Faraday started two educational initiatives that are still flourishing. The first was the Christmas Lectures for the schoolchildren of London and the environs. They instantly became triumphant successes, not least because Faraday himself gave them nineteen times. Sir George Porter, my predecessor as director of the RI, gave them twice, as did his predecessor, Sir Lawrence Bragg. I gave them once in 1988 (televised nationally by the BBC) on "Crystals". Many distinguished popularisers of science, including Sir David Attenborough, Carl Sagan, Philip Morrison and Richard Dawkins have given these Christmas Lectures.

The other initiative started in 1826 was the Friday Evening Discourses, given every year from early Autumn to late Spring. These popular lectures, intended for non-expert lay folk, were an instant success, again largely because Faraday set the tone (and range of topics discussed) – wherever possible with practical demonstrations or exhibits – during the space of one hour on a Friday evening in the theatre of the RI. In these discourses, Faraday performed brilliantly. His irresistible eloquence and compelling enthusiasm as he expatiated on the beauty of nature and when he lifted the veil from its deep mysteries carried him, and members of his audience, to the brink of ecstasy (see Figure 2).

Figure 2: Michael Faraday delivering one of his Christmas Lectures in 1856. Facing him is Prince Albert, regent of Queen Victoria, with two of his sons (one the Prince of Wales) on either side of him.

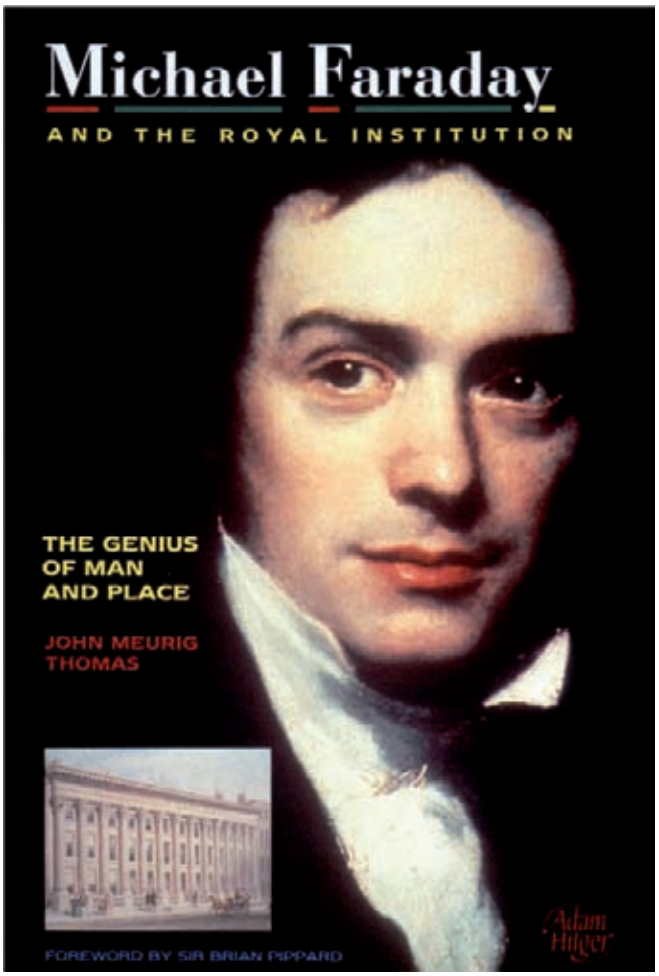
Michael Faraday took pains to make room in his lecture programme of Friday Evening Discourses for men of letters to elaborate upon their expertise in fields far removed from pure and applied science. Most of the talks and courses given at the RI in Faraday's days were, however, biased towards science, (or natural philosophy as it was then called) technology and practical considerations including the construction of tunnels and bridges as well as recent excavations by archaeologists and advances in astronomy (see Tables 1 & 2).

Table 1: A Selection of the Friday Evening Discourses Arranged by Michael Faraday

Date	Speaker	Topic
09/05/1834	John Dalton	On the Atomic Theory of Vapours
10/02/1843	Sir William R Grove	The Gaseous Voltaic Pile
04/02/1848	Sir Charles Lyell	The Age of the Volcanoes of Auvergne as Determined by the Remains of Successive Groups of Land-Quadrupeds
02/05/1851	Sir George Biddell Airy	On the Total Solar Eclipse of July 28 1851
30/05/1851	Sir Henry Creswicke Rawlinson	A Few Words on Babylon and Nineveh
24/02/1854	Henry Bence Jones	On the Acidity, Sweetness and Strength of Different Wines
15/06/1855	Sir Henry Creswicke Rawlinson	On the Results of the Excavations in Assyria and Babylonia
30/01/1857	Rev Frederick Denison Maurice	Milton Considered As A Schoolmaster
04/02/1859	Sir Richard Owen	On the Gorilla
12/04/1861	Hermann von Helmholtz	On the Application of the Law of the Conservation of Force to Organic Matter
19/04/1861	John Ruskin	On Tree Twigs
17/05/1861	James Clerk Maxwell	On the Theory of Three Primary Colours

Table 2: A Selection of the Friday Evening Discourses Given by Michael Faraday in the Period 1836-1861

Date	Topic
January 1836	Silicified Plants and Fossils
February 1836	The Magnetism of Metals as a General Character
April 1836	Plumbago and the Manufacture of Pencils from It
June 1837	Early Arts: The Bow and Arrow
February 1838	The Atmosphere of This and Other Planets
April 1842	Conduction of Electricity in Lightning Bolts
January 1846	Magnetism and Light
June 1848	Conversion of Diamond into Coke
April 1851	On Atmospheric Magnetism
June 1852	On the Physical Lines of Magnetic Force
March 1860	On Lighthouse Illumination – the Electric Light
February 1861	On Platinum



(1) John Meurig Thomas, "Michael Faraday and the Royal Institution: The Genius of Man and Place". Taylor & Francis, 1991

(2) An extended abstract of the plenary lecture given at Microscience 2010, London, 1st July 2010.

The cover photograph of the author's book on Faraday, see reference 2. This shows him at the age of 39.

In pondering the life and work of Faraday, it is fitting to recall Ben Johnson's description of Shakespeare: "He was not of an age, but for all time."

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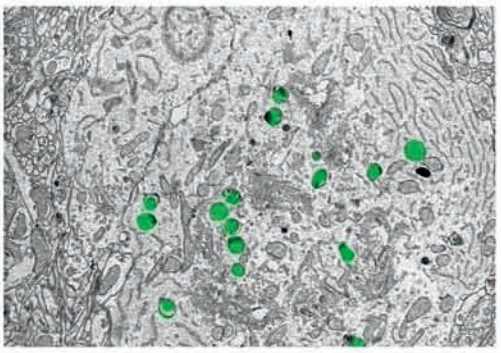

Ultra-thin section from the HVC region of a zebra finch brain.
Fluorescent labeling with Alexa 488, EM contrasting with potassium ferrocyanide and osmium tetroxide.
M. Kirschmann, D. Oberti, R. Hahnloser, Institute of Neuroinformatics, University of Zurich and ETH Zurich, Switzerland.
Images taken with an Axio Observer fluorescence microscope and a SUPRA® 40VP scanning electron microscope.

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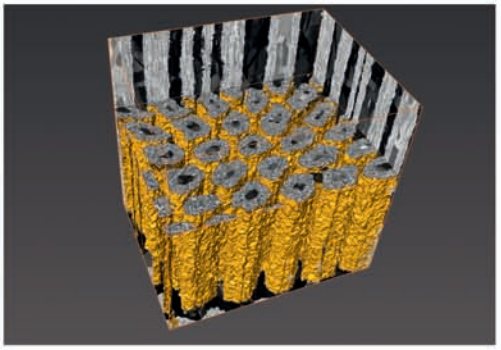

Multifilament superconductor Nb_3Sn in Cu Matrix;
voxel size: 10 x 10 x 10 nanometer.
Impressive sequels of images allow never before seen insights into the inner composition of materials – enabling researchers to optimize material properties. Image courtesy of Dr. Marco Cantoni, EPFL (Switzerland).

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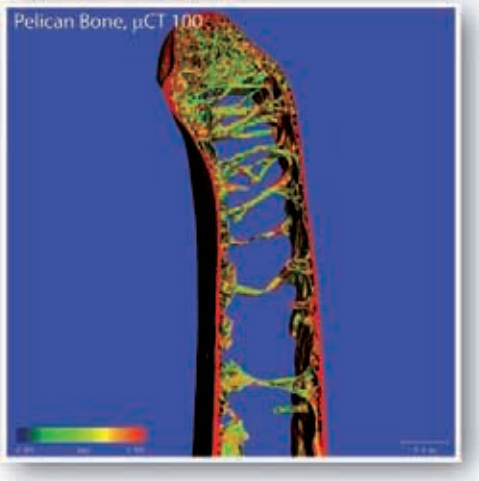

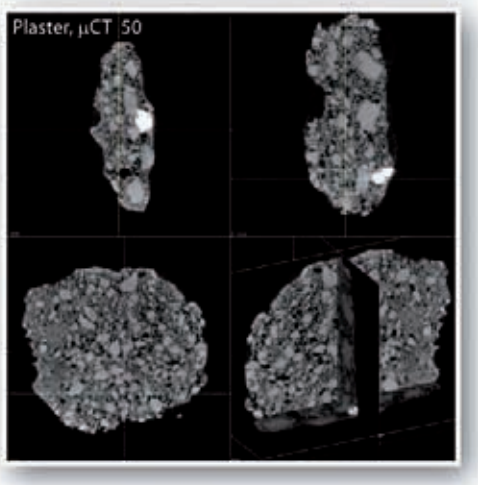

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REPORT ON EMS SPONSORED EVENTS

Notes :

« Past, present and future of (S)TEM and its applications : a tribute to Christian Colliex work »

June 9-11, 2010, CNRS Paris

This conference in honour of Christian Colliex featured eminent speakers from diverse backgrounds who presented the historical developments and the challenges for the future across the many domains to which Christian has contributed:

- Spatially-resolved electron energy loss spectroscopy
- Instrumental developments in electron and ion microscopy
- Elastic and inelastic coherence
- Biological applications
- Interface physics
- Nanotubes
- Clusters

CNRS Research Director
Head of the Electron Microscopy Group
Université Paris Sud
Laboratoire de Physiques des Solides
Orsay FRANCE

The conference took place in Paris at the CNRS headquarters from June 9th to June 11th 2010. The conference was a success, with more than 150 persons participating, with exciting scientific discussions during the posters sessions.

The major part of the invited lectures have been posted at http://eels.cc. The proceedings, also posted on this website, are a special document mixing ancient abstracts of Christian Colliex and state-of-the-art abstracts of related contributions at the meeting.

Invited speakers

Albert Fert	Thales France
Sumio Iijima	Meijo University, Japan
Catherine Brechignac	CNRS-France
Pulikel Ajayan	Rice University, U.S.A
Philip Batson	Rutgers University, U.S.A
Cheng-Hsuan	Chen National Taiwan University
Alan Craven	University of Glasgow, U.K
Alexandre Gloter	LPS Orsay France
Archie Howie	Cavendish Laboratories, U.K
Helmut Kohl	Universitaet Muenster, Germany
Ondrej Krivanek	NION, U.S.A
Richard Leapman	National Institute of Biomedical Imaging and Bioengineering, U.S.A
David Muller	Cornell University, U.S.A
Steve Pennycook	Oak Ridge National Laboratory, U.S.
John Spence	Arizona State University, U.S.A
Pierre Sudraud	Orsay Physics, France
Kazu Suenaga	AIST, Japan
Akira Tonomura	Hitachi Advance Research Laboratory Japan
Susana Trasobares	Universidad de Cadiz, Spain
Daniel Ugarte	Universidade Estadual de Campinas, Brazil

E-MRS 2010 SPRING MEETING

Strasbourg, France
June 7 - 11, 2010

Symposium Q: Quantitative electron microscopy for research and industry

Symposium Organizers:

Wolfgang Jaeger,
University of Kiel, Germany

Rafal Dunin-Borkowski,
Technical University of Denmark, Lyngby

Paul A. Midgley,
University of Cambridge, U.K.

Etienne Snoeck,
CEMES-CNRS Toulouse, France

Highlights

The symposium provided a forum for researchers interested in applying quantitative methods of electron microscopy and spectroscopy to materials research in different technology fields, such as electronics, optics, magnetics, energy and environment, engineered materials, nanosystems, soft matter and bioscience. This symposium was the first of its kind, with more than 60 contributions received from 19 countries, including Brazil, Israel, Japan, and the USA. Many participants of the symposium expressed their positive opinion about the scientific quality and the topical subject areas of this symposium, some suggested to organize this style of symposium in regular intervals within the series of E-MRS meetings. Numerous excellent contributions by scientists from industry, research institutions, and universities demonstrated convincingly the importance of quantitative electron microscopy methods in materials research, in applications dedicated to the development of new materials, and for the advanced analysis of materials in current areas of technology.

Part of the broad spectrum of topical areas was reflected by the invited speakers with their excellent contributions on *3D imaging for nano-electronics* (Hugo Bender, IMEC Leuven, Belgium), on *3D EBSD tomographic orientation microscopy* (Dierk Raabe, Max-Planck-Institut für Eisenforschung, Düsseldorf, Germany),on *In-situ electron microscopy in an aberration-corrected STEM* (Florian Banhart, Université de Strasbourg, France), on *Materials Science Applications with a New Electron Energy-loss Spectrometer* (Gerald Kothleitner, FELMI, Graz University of Technology, Austria), on *Magnetic imaging in a TEM on materials for future high density media* (Pascale Bayle - Guillemaud, CEA-Grenoble, France), on *Transmission Electron Microscopy studies of aluminium alloys* (John C Walmsley, SINTEF Materials and Chemistry and Norwegian University of Science and Technology, Trondheim, Norway), *on Using Electron Microscopy to Measure Interface Energy* (Wayne D. Kaplan, Technion Israel Institute of Technology, Haifa, Israel), and on *Quantitative electron microscopy to characterize solid oxide fuel cell degradation* (Aicha Hessler-Wyser, CIME and Laboratory of Industrial Energy Systems, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland). Furthermore the symposium could present two graduate student awards (fotos attached) for outstanding achievements of quantitative electron microscopy in materials science. The awards went to Marina Pfaff, Karlsruhe Institute of Technology, Karlsruhe, Germany, for her presentation entitled '*Semi-empirical equation for electron scattering at low energies in thin films consisting of light elements*' and to Vasfi Burak Özdöl, Stuttgart Center for Electron Microscopy, Max Planck Institute for Metals Research, Stuttgart, Germany, for his research on '*Strain Mapping by Dark-Field Inline Electron Holography*' in the characterization of novel semiconductor devices.

The symposium benefited also from the many excellent contributed papers. It is a particular pleasure to mention that the symposium could present 2 graduate student awards for outstanding achievements of quantitative electron microscopy in materials science:

- Marina Pfaff (Karlsruhe Institute of Technology, Karlsruhe, Germany) for her presentation entitled 'Semi-empirical equation for electron scattering at low energies in thin films consisting of light elements'

- Vasfi Burak Özdöl (Stuttgart Center for Electron Microscopy, Max Planck Institute for Metals Research, Stuttgart, Germany) for his research on 'Strain Mapping by Dark-Field Inline Electron Holography' in the characterization of novel semiconductor devices.

E-MRS Graduate Student Award Winners: Marina Pfaff (top, right) and Vasfi Burak Özdöl (bottom, right) receiving their awards from Thomas Lippert, Conference Chairman (left), and Francesco Priolo, E-MRS President (centre). Pictures courtesy of Wolfgang Jäger and E-MRS.

WEINSTEIN CARDIOVASCULAR DEVELOPMENT CONFERENCE

Royal Tropical Institute, Amsterdam, the Netherlands, May 20-22, 2010.

The 2010 Weinstein Cardiovascular Development Conference was held at the Royal Tropical Institute, Amsterdam, the Netherlands, May 20-22. The meeting was organized by a local committee of cardiovascular biologists from the University of Amsterdam, Amsterdam, the Netherlands and the University of Cincinnati, Cincinnati, OH, USA. There were 413 registrants (plus 16 partners), which is the largest number ever for the Weinstein Cardiovascular Development Conference. 166 (40%) were PhD students or junior postdoctoral fellows. 154 attendees were from North America, 221 from Europe, 35 from Asia, 2 from Australia and 2 from Africa. Platform presentations were selected by an American and European expert in the field, exclusively from submitted, and author and affiliation blinded abstracts. Nine platform sessions were held:

1) Transcription regulation (2),
2) Cardiac Progenitor Cells,
3) Epicardium,
4) Cardiac Signalling,
5) Genetics and Cardiovascular Malformations,
6) Valve Development,
7) Heart Fields,
8) Neural crest and Conduction System, and
9) Cardiomechanics.

Of the platform presentations, 78% were given by students or postdoctoral fellows and only 22% by principle investigators. All abstracts received (254 in total) were presented in 3 poster sessions. In addition to the nine platform sessions described above, one technical and tutorial session, entitled **"3D and Imaging techniques"**, was held. This workshop consisted of five presentations. Two presentations were by senior faculty providing an overview of 3D-modelling of the heart and of Optical coherence tomography. Subsequently, a senior researcher discussed how to quantify structures in 3D images, a PhD student on how to fit individual sections in 3D reconstructions, and finally a computer expert on how to present 3D images/data sets using 3D-PDF.

XXI INTERNATIONAL SYMPOSIUM OF MORPHOLOGICAL SCIENCES

September 18-22, 2010, Taormina-Messina, Italy.

Presidents: Guido Macchiarelli (L'Aquila) and Giuseppe Pio Anastasi (Messina)

The XXI International Symposium of Morphological Sciences (ISMS) was held in Taormina (Messina, Italy) from September 18-22, 2010 under the auspices of the International Committee of Symposia on Morphological Sciences (ICSMS), the International Federation of Association of Anatomists, The European Microscopy Society, The Italian Society of Anatomy and Histology, Italian Society for Microscopical Sciences.

The location of the conference center was the prestigious San Domenico Palace Hotel, located in the hearth of Taormina and with a wonderful view of the Tyrrhenian Sea. The Opening Ceremony, organized in the "Sala della Chiesa", the monastery's old church, was attended by more than 250 delegates coming from all the Continents.

The Scientific Program opened with a memorial session dedicated to the late Italian anatomist and famous microscopist, Pietro Motta. Twenty-two special symposia and workshops, were organized by international renowned Scientists. Each session was focused on modern aspects of the morphological sciences, with a special regard to the different microscopy techniques. All scientific events were fully participated. Main topics were Cell death and apoptosis, Educational anatomy, History of anatomical illustrations, Morphological and clinical advances of female fertility and sterility, Neuroendocrine imaging, Topography of inositide-depending signalin.

The event sponsored by EMS was the Plenary lecture of Prof. Yasuo Uchiyama, from Japan, entitled "Cell death and autophagy", in the session "Recent advances in studies of cell death". The followings topics were mainly developed in the workshops: Advances in microscopy methods and instrumentation, 3D imaging, Living cell imaging, SEM of vascular corrosion casts and related techniques, Tissue preparation techniques in TEM and SEM, Imaging and functional morphology of extracellular matrix, Neuro-modulation, Lymphatic system in basic and clinical medicine, Male infertility, Muscular morphophysiology, Spermatogenesis, Forensic anthropology. Two poster sessions on the Symposium topics, with a total of 52 posters, were displayed in the monastic "Piccolo Chiostro", a place of pray and relaxing for the Domenican friars that used to live in this site since late medieval times.

Moreover, the meetings of the International Committee of Symposia on Morphological Sciences; the International Federation of Association of Anatomists, the European Board of Anatomists and the Brazilian Society of Anatomy, were successfully organized. The next XXI Symposium was assigned to San Paulo, Brazil, in 2012. The social and convivial events were also fully attended: renewing the spirit of international friendship that always characterized the previous ISMSs. The welcome dinner took place on the seaside of the Hilton Hotel at Giardini di Naxos.

The Gala dinner was organized in the swimming pool area of the Capo Peloro Resort located at the northeast corner of Sicily, near the Ganzirri lakes of Messina. An elegant cocktail, with tasting of Sicilian fish and Italian sparkling wine, concluded all events in the wonderful frame of the Italian garden of the former San Domenico Abbey.

OTHER EMS SPONSORED EVENTS :

⇨ 4th CIMST Interdisciplinary Summer School on Bio-medical Imaging

September 6-17, 2010
ETH Zurich, Switzerland
Organization: Zurich Center for Imaging Science and Technology (CIMST)

⇨ IInd EMBO Practical Course on 3D Developmental Imaging

October 1-9, 2010
Instituto Gulbenkian de Ciência, Oeiras, Portugal
Organization: European Molecular Biology Organization (EMBO)

⇨ EELS/EFTEM Meeting 2010

October 27-29, 2010
ETH Zurich, Switzerland
Organization: Workgroup on Energy Filtering and Electron Energy Loss Spectroscopy (EF & EELS)

⇨ Nano-Molecular Analysis for Emerging Technologies IV

November 9-10, 2010
NPL, Teddington, UK
Organization: National Physical Laboratory

The lists of EMS sponsored lectures at these meetings is available at
www.eurmicsoc.org/spons_events.html

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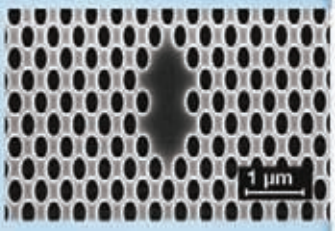

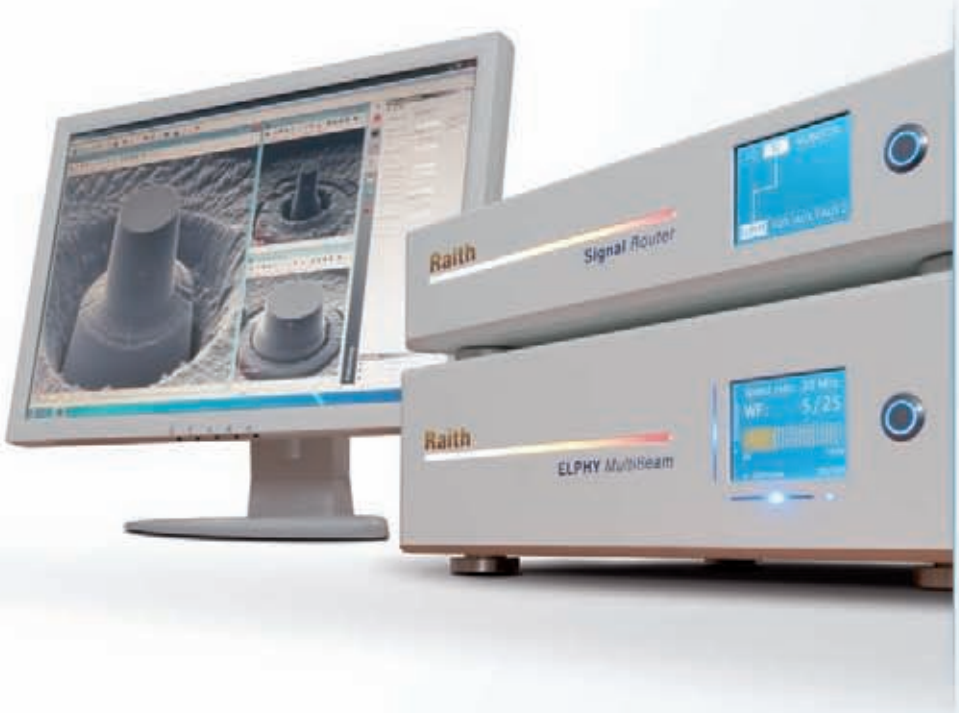

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- ✓ *Electron Beam Lithography*
- ✓ *Gas assisted Focused Electron Beam Induced Processing*
- ✓ *Helium Ion Beam Patterning*

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Features:

- Front Digital Dial Indicator displays real-time material removal/sample advancement, 1 micron resolution
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- Precision spindle design indexes sample perpendicular to the platen, and can rotate simultaneously
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- Automatic sample oscillation, adjustable sweep with 6 speeds
- Full or limited automatic sample rotation with 8 speeds
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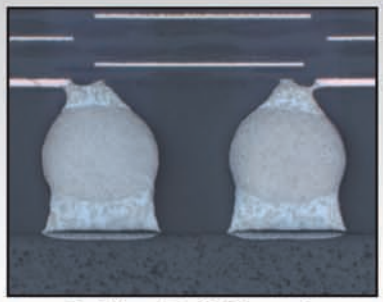
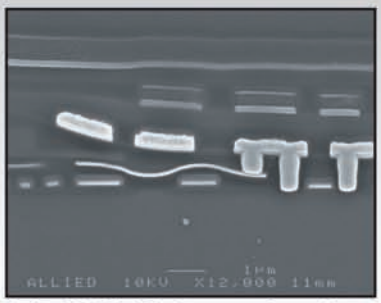
- Cam-locking system eliminates the need for tools and allows for exact repositioning of fixtures

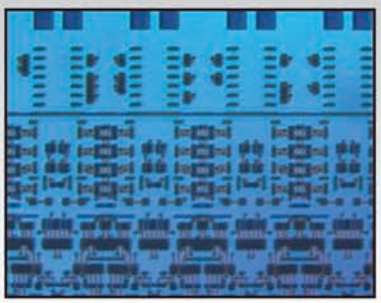
Unequalled Sample Preparation Results



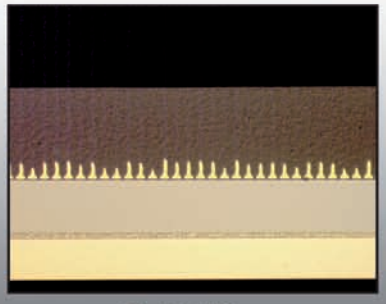
Solder Ball Mosaix



FE SEM IC Cross-Section



Parallel Delayering of an IC



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TEM Cross-Section of an IC

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REPORT ON SPECIAL EVENTS

Notes :

One special scientific day in Honor of Jean-Paul Morniroli …

One special scientific day in Honor of Jean-Paul Morniroli for his important contributions to electron microscopy and electron diffraction.

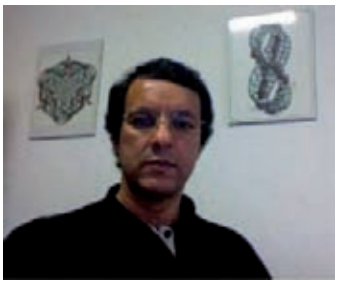
June 1st 2010 Lille - France

A celebration day in honor of Professor Jean-Paul Morniroli's retirement has been held at the University of Lille 1 the first of July 2010. The event was organized by the UMET (Unité Matériaux et Transformations, UMR 8207 CNRS – University of Lille 1) and the French Society of Microscopies (SFmu). About 60 participants coming from various countries (Belgium, Israel, France, United Kingdom, United States and Switzerland) have attended the workshop.

The speakers were international specialists of electron diffraction having collaborated with Jean-Paul Morniroli during his career. Among them were two members of the famous "Bristol's school" which lies at the origin of the convergent beam technique. The ultimate quantitative developments of the technique dedicated to electron crystallography have also been covered, as well as recent applications of the promising precession electron diffraction method.

Electron diffraction and defect characterisation,
David Cherns
(H.H. Wills Phys. Lab., Bristol)

Interpretation of innovative experiments with a TEM,
John Steeds
(H.H. Wills Phys. Lab., Bristol)



Microdiffraction : (Towards) a routine technique for crystal structure characterisation,
Abdelkrim Redjamia
(Nancy)

Inauguration of the Qu-Ant-EM in Antwerp:

Inauguration of the Qu-Ant-EM in Antwerp: discovering a new (nano) world.

June 28 – 10, Antwerp, Belgium

On June 28, 2010, a new transmission electron microscope has been inaugurated at the EMAT research group of the University of Antwerp. The instrument is state of the art, unique in Europe and opens new possibilities to discover the nano world.

Planning, designing, getting financial support and building up the instrument took about four years. A breakthrough came in 2008 with a Hercules financing of 4.2 MEuro from the Flemish government. Together with financial support from UMICORE and IMEC, a contract was signed with FEI company to produce a unique electron microscope. This instrument belongs to the Titan-in-a-box series and is able to function in normal TEM as well as STEM mode. In both modes, the lenses are corrected for aberrations.

The development and assembly started at FEI Eindhoven in 2009. In the meantime, the nearly 45 year old EMAT high voltage electron microscope was dismantled and the room was adapted to receive the new instrument. Because of the extreme sensitivity of the microscope, this room is acoustically, thermally and magnetically isolated from the rest of the world. The instrument was shipped to Antwerp in March 2010. It took about three months to install the instrument and to perform the acceptance tests.

The microscope is remote controlled from a position outside the microscope room. This allows one to shield the microscope column from its environment by a dedicated enclosure. As a result, the microscope actually looks more like an American fridge or a huge coffee machine than a conventional TEM.

Possibilities and performance

The new microscope is not only equipped with aberration correctors for TEM and STEM, but also a high brightness electron gun and monochromator are installed in the column. In addition to structural information, chemical and electronic data can be

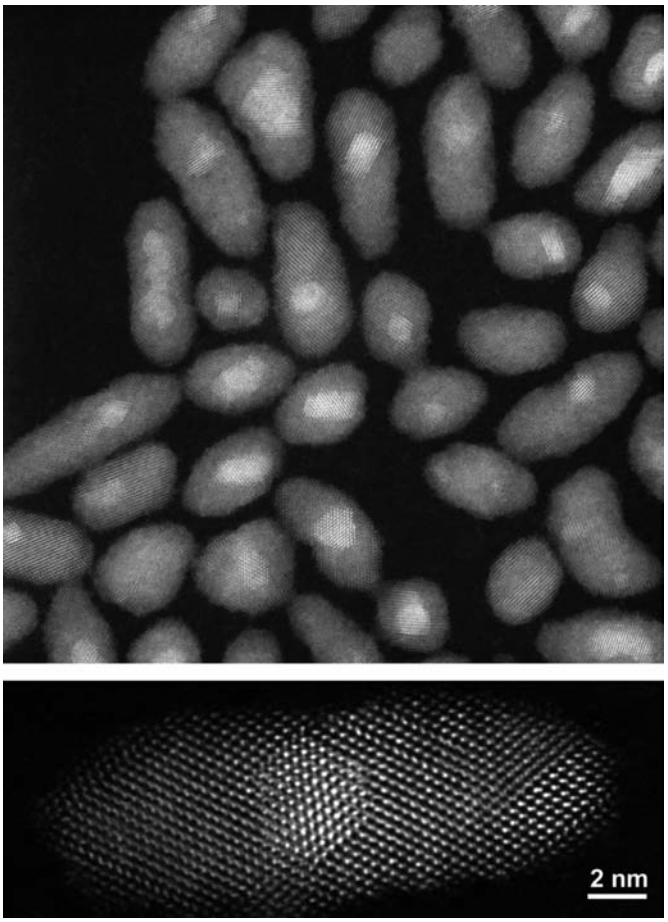
The Qu-Ant-EM microscope in its cube enclosure and dedicated environmentally shielded room

obtained through the state-of-the-art spectrometer. The design of the microscope allows us to obtain a spatial resolution of 50 pm in TEM mode, 80 pm in STEM mode and an energy resolution of 150 meV. Both the increased brightness and energy resolution make this electron microscope in specific cases a competitor to the best synchrotrons available. The advantage of our machine is the fact that we can study materials, including defects, interfaces and low dimensional structures on a local scale within the pm range.

Another main advantage of the new microscope is its flexibility. We will not only be able to operate the microscope at the conventional acceleration voltage of 300 kV, the microscope is also able to obtain results at 200 and 80 kV. Because of the aberration correctors, this can be done without significant loss of spatial

discovering a new (nano) world.

Remote control of the Qu-Ant-EM microscope from the separated control room



Z-contrast STEM image of CdSe/PbSe nanorods. The PbSe core can be distinguished from the CdSe shell because of their difference in atomic number

resolution. Since beam damage is reduced at such low voltages, operating the Qu-Ant-Em at 80 kV is of great importance to study soft matter, such as graphene, carbon nanotubes and biological materials. Without the effect of radiation damage, we are now able to study the true, atomic structure of, e.g., carbon nanotubes.

Research projects

The new microscope will allow the group to pursue several exciting research projects such as

- to obtain information about the magnetic state of a material at atomic resolution using spin specific selection rules at inelastic transitions and the breaking of the circular symmetry of the microscope-detector positioning (similar to X-ray magnetic circular dichroism imaging)

- to study the relation between the macroscopic behavior and the electronic properties of interfaces in, e.g., perovskite oxides at an atomic scale by combining STEM for Z-contrast and EELS for valence state information, bonding type, band gap, plasmon oscillations and local concentration of elements

- to reconstruct the three-dimensional atomic structure of nanosystems by using in-depth sectioning with a reduced STEM probe-size

In all of these cases the improved resolution and precision will enable engineers to further optimize their materials modelling and design. Collaborations with other laboratories and industry in national and international projects will ensure a wide exposure of the power of this new instrument.

G. Van Tendeloo
EMAT Director

Conference in Honor of Professor David Cockayne's Retirement

Electron Microscopy and Diffraction of Defects, Nanostructures, Interfaces and Amorphous Materials

University of Oxford
Department of Materials

To mark the retirement of Professor David Cockayne, a special one-day meeting was held at the University of Oxford, Department of Experimental Psychology (2009). To reflect the research interests of Professor Cockayne, the themes of the meeting were focussed on:

Weak beam microscopy – technique and applications

Applications of electron diffraction

Characterisation of nanoscale structures and interfaces

Organising Committee:
Professor Sir Peter Hirsch
Professor Angus Kirkland
Dr Peter Nellist
Mrs Katherine Hartwell

During the production of this Yearbook,
David Cockayne FRS
passed away after a long illness.
He will be missed greatly by the microscopy community around the world. PAM and NS.

Report on the Symposium in Honor of Prof. Dr. Max Haider and Prof. Dr. Harald Rose

Heidelberg, Germany, on February 19th, 2010

In the past two decades, no other technological or methodological development has influenced or changed the field of Transmission Electron Microscopy to the same degree as the aberration correctors in electron optical imaging. As was the case with many groundbreaking developments in the past, this success was coupled to the cooperation of unique and leading scientists in the field, who complement each other in their view of science as such and in their understanding of how to solve a unique problem – and who are determined to achieve their goal. Early in 2010, it was overdue to celebrate the birthdays of two scientists, who are protagonists in the field of aberration correction of electron optic lenses: the 60th birthday of Max Haider, and the 75th birthday of Harald Rose.

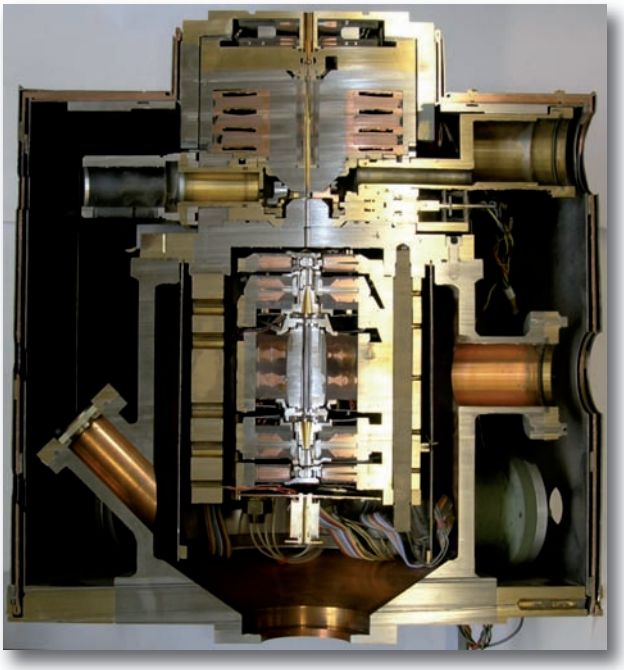
Impressions from the Symposium: Max Haider and Harald Rose (centre), images showing the first applicants of the correctors for spherical and chromatic aberration, Knut Urban (bottom right), and Bernd Kabius (top row, centre left), Hannes Lichte (top row, centre right), and the organizers of the symposium, Dagmar Gerthsen, Joachim Zach, and Rasmus Schröder.

Both have been closely collaborating in this field for decades. Max Haider was the first to demonstrate in his diploma thesis (1982) that the so called "Darmstadt Corrector", due to its dodecapole lens design, was able to correct chromatic and spherical aberrations (published in: Haider M, Bernhardt W, and Rose H., 1982: Design and test of an electric and magnetic dodecapole lens. Optik 63, 9). Owing to technical difficulties, however, there was not yet any improvement of the resolution limit,, at that time, although the correction of spherical aberration was successfully accomplished. Harald Rose himself was the Spiritus Rector of the Darmstadt group of particle optics, "father" of the theory of modern aberration correctors, indefatigable advocate for modern particle optics and its application in novel imaging modes in the area of material and life sciences. A theoretical paper describing the prerequisites of the optical design (Rose H., 1990: The Cs-correctors use hexapoles in an arrangement with additional round lenses. Optik 85, 19) and the first experimental results with a corrected electron microscope (Haider M., Uhlemann S., Schwan E., Rose H., Kabius B., and Urban K., 1998, Electron microscopy image enhanced. Nature 392, 768) paved the way for a new world of electron microscopy.

"Darmstadt-Corrector": the image shows the longitudinal cross section through its final version, with the dodecapole lense in the middle, as developed and tested by Max Haider in his diploma thesis.

In the following years, this was honored with the Beckurts Price (2006) and the Honda Price (2008) to Max Haider, Harald Rose, and to Knut Urban, who always supported this work and was among the first successful applicants of this technique.

It was a logical step to celebrate and honor both scientists on the occasion of their birthdays with a



Dodecapole – the dodecapole lens of the present version of the hexapole Cs-corrector.

symposium on "Advances in Corrected Electron Microscopy in Material Science and Biology". It was the aim of the symposium to identify and highlight the common interest in using the new, corrected electron microscopes in material and life science. About 150 participants - scientists, developers from industry, friends and colleagues - came to Heidelberg, from Germany and abroad, in order to listen to the wide spectrum of scientific talks. The first talk was given by Joachim Zach, who was a companion of Max Haider from the early beginning, and whose contributions were fundamental for the success of aberration correction. He first looked back to the early years at the University of Darmstadt, and then reported about the foundation of the company CEOS and its worldwide success story. The second speaker, Knut Urban (ERC, Research Centre Jülich), who was among the very first dedicated applicants in high-resolution transmission electron microscopy, emphasized the new PICO, the first microscope in Europe with a corrector for spherical and chromatic aberration, which will be installed in the near future at the Ernst-Ruska-Centre in Jülich. The microscope is based on the experience and success of the so-called TEAM project. Within this project, a resolution of 0.5 Ångstrøm was achieved. The correctors for these electron microscopes were naturally developed in the company CEOS, by a team led by Max Haider and Joachim Zach. It was exciting

for all participants to listen to the talk given by Bernd Kabius (Argonne National Laboratory), who was able to show the latest results of the TEAM project, focusing on imaging by inelastically scattered electrons, which is achieved due to the correction of chromatic aberrations.

Further talks were given by Martin Hytch (Toulouse) focusing on applications of aberration correction in the field of material science, and Holger Stark (a biologist from the MPI in Göttingen), illustrating the huge potential in biology by using the new imaging techniques on the basis of aberration correction. Ute Kaiser (University of Ulm), Henning Stahlberg (Biocentre Basel), and Roger Wepf (Zürich) highlighted new applications expected in the near future. Finally, Harald Rose himself gave a personal resumé, looking back to the initial stages of the whole project when the financing and support of aberration correction was often uncertain, and when reviewers raised concerns whether this was possible at all. However, he also expressed his great satisfaction and relief when all parts finally were assembled and shown to function satisfactorily. It was delightful to see the great pleasure of both scientists, Max Haider and Harald Rose, celebrating their jubilee, when their achievements were presented, based on their scientific merits.

Presentation of the gift of the DGE – Max Haider and Harald Rose, while the gift is presented by the president of the DGE, Reinhard Rachel

This report ends with brief citations of two participants of this symposium, which hardly require any additions. The current director of the Ernst-Ruska-Centre in Jülich, Knut Urban, already wrote in 2008: "Seventy-five years after its invention, transmission electron microscopy has taken a great step forward with the introduction of aberration-corrected electron optics." (Science 321, 506). As a summary of the symposium, the president of the DGE, the German Society of Electron Microscopy, is cited: "It was wonderful to have scientists of a variety of disciplines – physicists and theoreticians, material scientists and biologists – sitting in one room, intensively and interdisciplinarily discussing with each other, with no escape."

After the scientific discussions, there was a wonderful party, with a lot of personal and official gifts presented to both, Max Haider and Harald Rose, and thanks are due to the sponsors who generously supported this event (FEI, Hitachi, JEOL, and Zeiss).

Rasmus Schröder (Heidelberg),
and Dagmar Gerthsen (Karlsruhe)

Max Haider and Harald Rose,
after having received further gifts from colleagues.

Notes :

REPORT ON SCHOLARSHIPS

Notes :

SCHOLARSHIPS AWARDED IN 2010

In **2010**, 16 scholarships of each 250€ were awarded for participation at one of the EMS Extensions and 15 scholarships of each 500 € for the participation at IMC17. Applicants must be EMS members and must submit at least one abstract and be registered at the meeting. See detailled information at the following address:

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

IMC17: 5 by EMS (green) 10 by JEOL through EMS (white), 500€ each

Name	Society	Affiliation
Natalya Dudkina	NVvM	University of Groningen, Netherlands
Ozgur Duygulu	TEMD	Istanbul Technical University, Turkey
Haibo E.	RMS	University of Oxford, England
Lewis Zhen-Yu Liu	RMS	University of Cambridge, England
Axel Lubk	DGE	CNRS Toulouse, France
Katharina Marquardt	DGE	University of Potsdam, Germany
Eva McGuire	RMS	Imperial College London, UK
Leopoldo Molina-Luna	DGE	University of Antwerp, Belgium
Hannah Catherine Nerl	IOP	Imperial College London, UK
Burak Ozdol	DGE	MPI, Stuttgart, Germany
Milivoj Plodinec	CSEM	University of Zagreb, Croatia
Matej Pospiech	CSMS	University of Brno, Czech Rep.
Stuart Turner	BVM/SBM	University of Antwerp, Belgium
Peng Wang	RMS	University of Oxford, UK
Zuzana Rezacova Lukaskova	CSMS	University of Brno, Czech Rep.

SCANDEM 2010 : 7 supported by EMS, 250€ each

Name	Society	Affiliation
Martin Ek	SCANDEM	Lund University, Sweden
Justinas Palisaitis	SCANDEM	Linköpings University, Sweden
Johan Mikael Persson	SCANDEM	Center of Lyngby, Denmark
Therese Sørheim Stokkan	SCANDEM	University of Oslo, Norway
Fredrik Sydow Hage	SCANDEM	University of Oslo, Norway
Paula Upla	SCANDEM	University of Jyväskylä, Finland
Kjetil Valset	SCANDEM	University of Oslo, Norway

MICROSCIENCE 2010 : 9 supported by EMS, 250€ each

Name	Society	Affiliation
Priyanka Pandey	RMS	University of Warwick, Coventry, UK
Giulio Auciello	RMS	Università Tor Vergata, Rome, Italy
Leonardo Lari	SISM	University of Sheffield, UK
Frederic Leroux	BVM/SBM	University of Antwerp, Belgium
Amy Wang	BVM/SBM	University of Antwerp, Belgium
Aiden James Lockwood	EMAG	University of Sheffield, UK
Herbert Reingruber	ASEM	ACEM of Graz, Austria
Dmytro Nikolayevich Tishko	Individual member	V.N. Karazin Kharkov Nat. University, Ukraine
Robert Jonathan Milne	EMAG	University of Sheffield, UK

Short reports from awarded students (MICROSCIENCE, SCANDEM, IMC17)

Reports from students who received a scholarship from EMS to attend MICROSCIENCE, SCANDEM, IMC17

A - MICROSCIENCE 2010

Dr Aiden J Lockwood - University of Sheffield

The biennial Microscience meeting, held at the ExCeL International Conference Centre in London, brings together a great selection of scientists and engineers from a wide range of backgrounds. Life sciences and physical sciences were together represented at Microscience with users of both electron and light microscopy. Microscience has now the biggest exhibition of its kind in the UK, with exhibitors enthusiastically showing off their new products, giving hands on workshops and all the usual free paraphernalia. Around the exhibition hall, many wild and wonderful images from science hung, as part of the RMS micrograph competition, with exceptional prizes kindly donated from many of the exhibitors. The poster area at Microscience gave a lot of people, including myself, the opportunity to show off their work and there was a definite buzz from the area. My only criticism would be that it was perhaps a little squashed.

This years meeting highlighted the expanding range, and potential of combined microscopy techniques. Many manufacturers and researchers displayed a broad array of new and novel experimental techniques, ranging from moveable scanning probes inside microscopes, allowing nanoscale interactions and precise object selection, to Atmospheric SEMs capable of imaging cells in solution. Another focus shown in many talks was over dynamic understanding, in again both physical and life sciences. With modern powerful imaging techniques, and even 3D tomography, the next step is towards realising time dependant analysis.

On of my personal highlights was the plenary lecture, delivered by Prof Sir John Meurig Thomas (Cambridge), speaking on the subject, 'The Genius of Michael Faraday'. Not only did Sir John endeavour to convey the fascinating history of Faraday, but did so in a highly entertaining manner, which captivated the entire audience. Another invited talk which captured my curiosity was given by Dr Tom Pike, (ICL) discussing 'Microscopy of Mars', which stirred up some future interest to land a SEM on the martian surface. Overall, it was a very enjoyable and useful meeting. I look forward to attending the joint EMC and MICROSCIENCE event, in Manchester in 2012.

Looking west from the ExCeL Centre, London, along the Royal Victoria Dock. The O2 Arena (Millennium Dome) and Canary Wharf are visible in the background.

Amy Wang - University Antwerp, Belgium

Thanks to the support of EMS, I did my first public lecture at an international conference. It was quite an experience and I received good comments for my presentation and several questions afterwards. I mainly followed the lectures in materials science and new techniques and frontiers and most of the lecturers showed interesting results from different advanced microscopes. And among all, I enjoyed a wonderful lecture from Sir John M. Thomas, who gave an overwhelming story of M. Faraday. Furthermore, I very much like the learning zone program organized by the

Short reports from awarded students (MICROSCIENCE, SCANDEM, IMC17)

RMS. It provided wide and easy-follow introductions to several microscopes. Also, the workshops in area 1 and 2 and during lunch breaks as well provided mostly by companies seemed quite a success to learn more practical details. Overall, I learned some interesting new applications and techniques in nano-materials during the conference.

Robert Milne - University of Sheffield
(EMS travel scholarship awardee)

Set in the docklands area in London, Microscience 2010 was held on the 28th June to 1st July 2010. Within ExCeL's large halls, a vast array of microscopes, equipment and techniques were on display at the exhibition, along with the three days of conference running in parallel. The exhibition was a great way to see the latest technology and get hands on experience as well as having your questions answered by the knowledgeable staff.

The conference yielded some very interesting talks, from the plenary lectures to the individual sessions, covering a broad range of techniques and materials. Several of the highlights included the plenary talk on 'The Genius of Michael Faraday' by Sir John Meurig Thomas (The University of Cambridge) and the invited talk of 'Nano patterning with a helium ion microscope' by Dr Paul Alkemade (Delft University of Technology). With a large gathering of international researchers with different subject areas and methods it was a great way to pick up techniques and ideas you may not have already conceived. As a young researcher it is a valuable experience to be able to listen to and ask questions of those who have more experience in the field of microscopy. From personal experience, I found presenting a poster was also a great way to publicise recent research and allow others to ask questions about current and future work.

As well as the talks and exhibition, Microscience had an active social programme which allowed you to chat to others whose subject area is vastly different to your own. There were several drinks receptions and Wednesday night lead to the conference's main social event, which took the guise of a BBQ and live band. This was a well attended event and enjoyed by all.

Overall the conference was an enjoyable and valuable learning experience and I shall look forward to attending the EMC 2012.

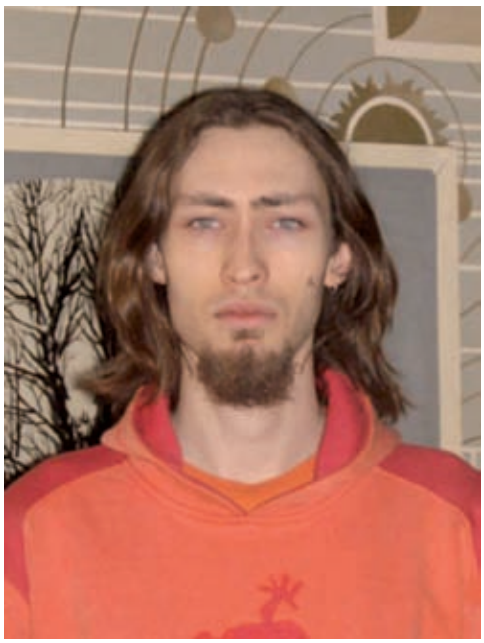
View of the Royal Victoria Dock from the plaza of the ExCeL conference centre.

Dmitry Tishko - Kharkov National University, Ukraine

I am a young researcher at Laboratory of Holography, Kharkov National University, Ukraine, working in the branch of holographic interference microscopy.

I was awarded by the EMS scholarship and had the splendid possibility to communicate my scientific results to colleagues and present the poster "Application of the digital holographic microinterferometry method for investigation of human blood erythrocyte pathomorphology" at the largest event of the year MICROSCIENCE 2010.

I was extremely exited to be a participant of the event. The climate of the conference was friendly. The high



level of the presented results and microscopy equipment has impressed me!

I think that participation in such events is of great importance for a young researcher. I could meet and hear the outstanding scientists from different countries. Communications with the colleagues gave me many valuable experiences. I could see the main problems which the modern microscopy solves; estimate the level of my work. These valuable three days gave me a real impulse for the further work.

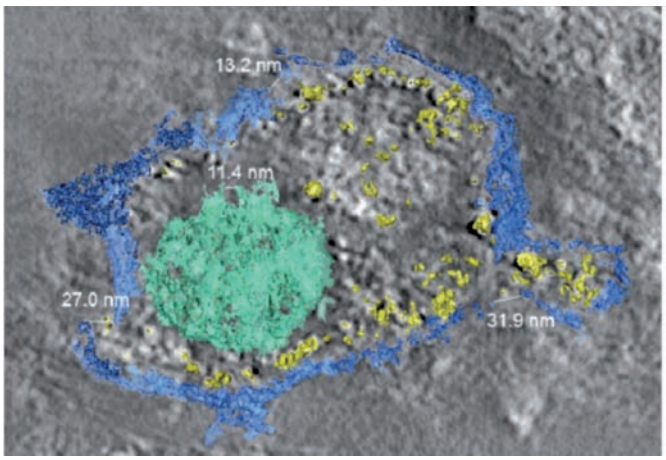
I am very thankful for the EMS for the possibility, and look forward to participating at the next conference!

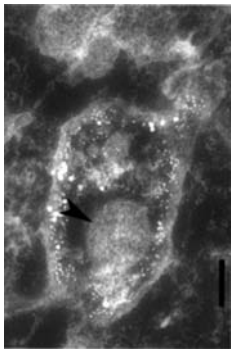
B - SCANDEM 2010

Paula Upla - University of Jyväskylä, Finland

The Scandem high-resolution microscopy meeting 2010 was very fruitful and good experience to me. The size of the meeting was adequate, with little less than 200 participants. Consequently, it was easy to get to know people and talk to them. I also sensed the good atmosphere there and immediately felt belonging to the group.

Scandem was a good combination of expertise on material and life science. The days started with plenary sessions for material and life scientists. Although my interest is in life science and I found the other talks a bit difficult to follow, it was anyway informative to see how different things can be studied by similar methods. Innovative findings that the world-leading scientists presented, exhibited newest techniques in the area but also the possible problems in usage of them. I started to plan how I could promote my own research of viral entry if I could combine two methods: fluorescent labeling with antibodies to cryo electron tomography. Or, if I could image intact and unstained cells in their almost native state by absorbing x-ray photons followed by reconstructions. In the future, hopefully many scientific relapses may be overcome by these kind of novel sophisticated applications. Since I possibly move from the traditional TEM to structural biology and electron tomography in the times coming, I was pleased to listen to talks of 3D EM methods and their applications on the very basic level. All in all, the talks were excellent and the speakers had outstanding skills of oral presentation. That was one thing that I could learn something of: how to summarize your results in an interesting and skilful way.





Electron tomography reveals breakages in internal vesicles and the limiting membrane of 2-multivesicular bodies (2-MVBs).

The meeting was versatile. For those who wanted, workshops were organized to learn things in practice and all the time commercial exhibitors were available. They also gave short presentations to introduce the newest microscopes and software while we enjoyed refreshments. I had expressed my willingness to speak also but the board did not make the decision in time so no one gave a presentation selected from the abstracts. Instead, I showed our latest findings of the echovirus 1 studies at a poster, and presented a mechanism how an RNA virus genome can get released from an intracellular organelle with the help or proteases (Figure 1). As a result, I was awarded a prize of the best life science poster at dinner in Vasa museum. It was a great ending for the great meeting.

Martin Ek - Lund University, Sweden

In this year's Scandem meeting in Stockholm I presented a poster on the effects of Zn doping on InP nanowires. There were others in the posters section reporting work on either similar materials or using similar techniques, which always makes for interesting discussions. Previously I have only attended one other international conference: last year's Scandem in Reykjavik.

I very much enjoy the broad scope of the Scandem meetings with presentations both far outside my own field and others very specialized in techniques that are relevant to my work. In the former category there was a talk on x-ray tomography of single cells that I found very inspiring and enlightening as a layman. Because of the yearly meeting and the size of the community you really get to know the other attendants and you also meet friends from your undergraduate days. This makes it much easier to have more informal discussions and this is a very important function for these types of events, in my opinion.

I would like to thank EMS for the scholarship that helped finance this trip. I am definitively hoping to attend more Scandem meetings in the future.

Therese Sørheim Stokkan - University of Oslo, Norway

As a master student in the field of structure physics I found it very interesting to attend the Scandem 2010 conference in Stockholm. It was inspiring to learn a bit about different methods and techniques in the material sciences, and to have some of these demonstrated in workshops and tours. The informal setting made it easy to talk to the companies present about new devices and instruments, and also to come in contact with lecturers and other attendants of the conference. Being a fresh scientist it was not always easy to know what to ask or what to talk about, but then I found it very useful to listen to other more experienced scientists conversations. All in all the conference gave me a bit more perspective in the field of material sciences, inspiration to continue in this field and to explore the use of different methods to solve a problem.

C – IMC 17

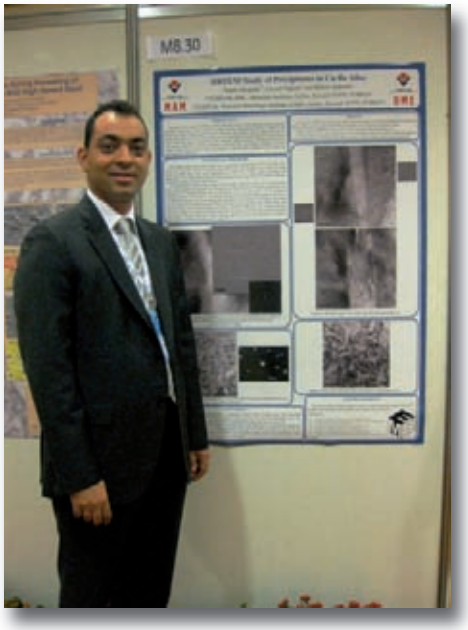
Zuzana Rezacova Lukaskova - University of Brno, Czech Rep

I would like to thank EMS for scholarship which helped me to go to IMC 17 in Rio de Janeiro this September. It was a great experience and also the biggest congress I have ever attended. I presented the results of my research in the form of a poster. The discussions with other scientists from the Plant Science and Life Sciences during the poster presentation was very interesting and inspirational. I have also gained new contacts and new information about latest trends in microscopic methods.

I attended many presentations and plenary lectures and I learned many new information about NanoSEM, TEM, 3D Microscopy... which is useful for my studies and also for teachings in our department.

Ozgur Duygulu - University of Istanbul Turkey

At the 17th International Microscopy Congress, IMC-17, which was held in Rio de Janeiro, Brazil from 19 to 24 September 2010, I presented the poster titled "HRTEM Study of Precipitates in Cu-Be Alloy" during the first poster session on Monday 21st September at 18:30 with poster number M8.30.



During the conference I had the chance to attend the lectures especially related to metal alloys, other materials science subjects and instrumentation techniques. I also met with new people and visited the exhibition. All of those will be very helpful for my future studies. I want to acknowledge the support from JEOL Europe with the help of the European Microscopy Society (EMS) again. Without the support of EMS it would not have been possible to have the opportunity of attending the IMC-17 conference and gain this kind of knowledge and experience.

I have put the acknowledgment and EMS logo as shown in the picture below which was taken during the poster presentation.

Matej Pospiech - University of Brno, Czech Rep

At first I would like to express special thanks for the financial support that enabled me to participate in International Microscopy Congress17 in Rio de Janeiro. My participation in the IMC 17 was of great benefit for me in the professional field and it also allowed me to expand knowledge of various types of microscopies and applied microscopic methods in practice. From the scientific point of view, I had the opportunity to learn about new trends in microscopic methods, new plans and improvements not only in the field of microscopy and light microscopy relating to my profession, but also fluorescent, electron, and confocal microscopies etc. In terms of my further scientific activities, practical knowledge from Oral presentations and Poster presentations, in particular from the Plant science and Life sciences, were very beneficial for me.

Participation in the IMC 17 also allowed me to obtain contacts from experts in my field and I believe that these contacts and arrangements will lead to progress in my research - microscopic methods in food microscopy.

I admired great organization of IMC 17, which was certainly not easy in such a large participation, as well as lively discussion at Poster presentations.I look forward to the IMC 18 in Prague and I hope that, as in the IMC17, I will be able to contribute my knowledge from food microscopy.

V. Burak Özdöl - Max Planck Institut
Stuttgart Germany

Impressions on IMC-17

Being financially supported by EMS, taking part in IMC-17 meeting has been a unique experience in many

folds. Apart from the particular microscopy fields covering my research interests like strain mapping in semiconductors, HRTEM and electron holography; following very recent applications of aberration-corrected electron microscopy both in imaging and analytical investigations of nanostructures was invaluable. It was interesting not only from the microscopy point of view but also from the materials science perspective: To see how the improvements in both spatial and spectral resolution of state of the art microscopes can trigger the investigation of materials like complex crystals or single layer graphene, etc. IMC-17 has covered broad range of scientific fields from physical to biological sciences. Plenary lectures and numerous invited talks helped me to visualize the tremendous progress in electron microscopy over the decades. As a PhD student focused on a specific methodology in electron microscopy, to discuss with the experts of electron microscopy as well as other young scientists from all over the world working on very different but interesting topics was great experience. I would like to thank EMS for the financial support which made it possible for me to present my recent results in front of the pioneers of the field.

Katharina Marquardt - PhD University of Postdam Germany; Post Doc at the NCEM Berkeley-USA

It is a great pleasure to report on the IMC 17 in Rio de Janeiro, which I could attend thanks to one of the 15 EMS scholarships. It turned out to be an excellent meeting. The scholarship allowed me to present and discuss my scientific results with colleagues, who have performed similar research and have been working on the same material. Thereby, I gained important knowledge concerning TEM methods as well as analytical software that could be of use for my area of research in further studies, for instance to quantify strain in my specific sample material. I think that I got a broad overview about new developments and possibilities to address scientific problems and experimental challenges. I would also like to highlight the plenary lecture by C.J. Humphreys, which was dedicated to show how TEM may help to solve the energy problem - this talk impressed me a lot. Being still new to the field of TEM, I very much enjoyed listening to the "popes of microscopy" and to finally connect a person to a name.

In summary, the quality of the talks was excellent. Unfortunately, I found that it was often very difficult to decide what talk to attend as numerous similar sessions ran parallel, and once or twice I felt like I didn't make the prime choice.

Axel Lubk - PhD Dresden Germay;
Post Doc CEMES-Toulouse France

To me, the IMC2010 in Rio offered excellent contact, discussion and learning opportunities. The presence of many outstanding scientists from around the world and the (actually a bit too) large number of different presentations offered the possibility to discuss many scientific problems, to deepen ongoing and future research collaborations and to gain an overview of the field of microscopy. Furthermore, by speaking to various manufacturers it was possible to gain insight into their newest developments and to snatch some refreshment, which was otherwise a bit difficult to get. A most welcome contrast to the long and sometimes a bit exhausting congress schedule (9am-20pm) were the long lunch breaks at Barra beach directly in front of the conference site as well the festivities organized by the conference and some manufacturers. In contrast to the massively parallelized, fast succeeding 12 minute talks one could have a longer chat and exchange thoughts with all sorts of interesting people from around the world. Last but not least Rio de Janeiro was a wonderful host, offering many different perspectives as a city. I enjoyed this conference.

Some additional reports are also available on the website

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REPORT FROM THE TREASURER

EUROPEAN MICROSCOPY SOCIETIES

EUROPEAN CORPORATE MEMBER ASSEMBLY (ECMA)

EMS CALENDAR 2011

APPLICATION FORMS (MEMBERS - ECMA)

Notes :

FINANCES 2010

Incomings

The major revenues originate from contributions of EMS members of the national societies and of ECMA members. Revenues of approx. 36,000 € are expected.

Expenses

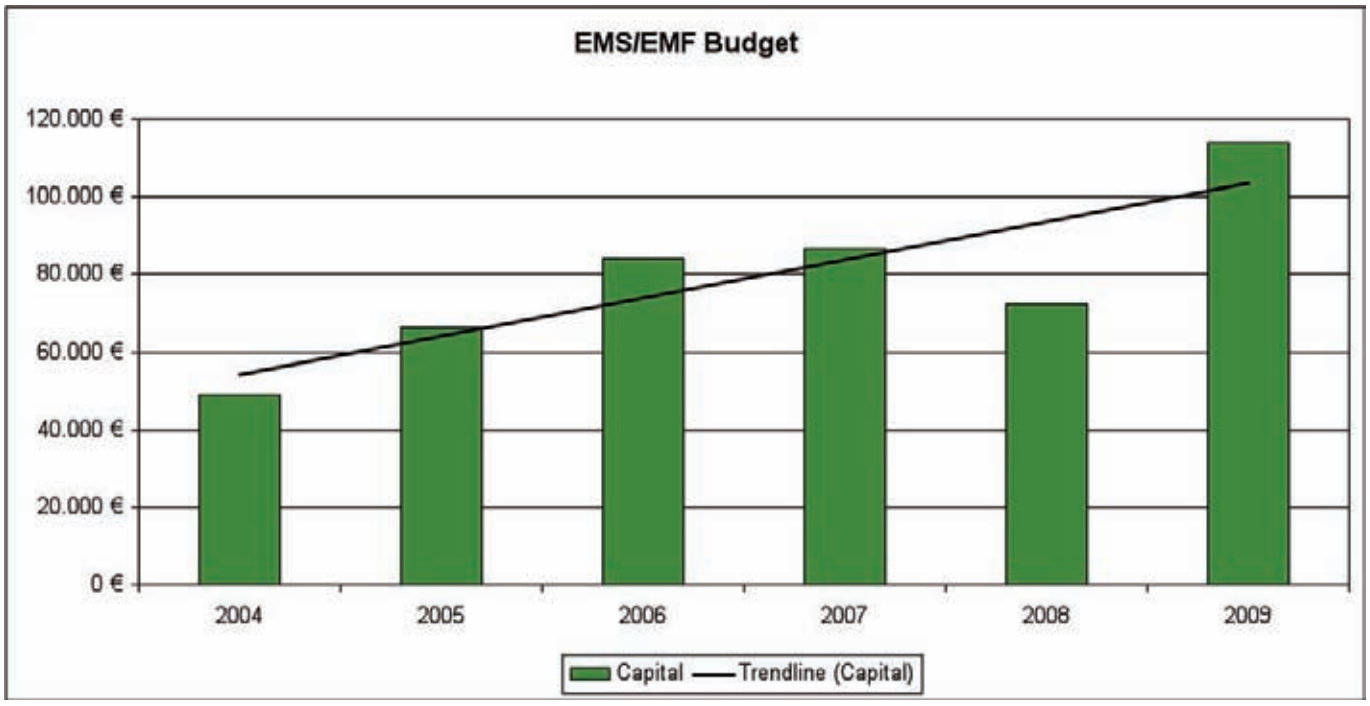
The two EMS Extension meetings 2010 supported by covering 2 invited speakers each (1 speaker 750 € max.); in total 3,000 €. Also, EMS supported 9 young scientists for their participation in MICROSCIENCE and 7 colleagues for attending SCANDEM with 250 € each (4,000 € total). Additionally, EMS supported 5 scholarships for young European microscopists to attend the IMC 17 in Rio with 500 € each (2,500 € total). In 2010, EMS supported 8 sponsored meetings, each with 750 € (6,000 € total). Costs for administration including half-time secretary and a board meeting held in Basel (February 18th and 19th, 2010) amounts to 25,326 €. In sum, the expenses 2010 equal 40,826 €.

The small deficit is a consequence of the decision to exceptionally support two extension meetings this year and to issue the IMC scholarships for IMC 17. The missing amount will be balanced by the EMS capital.

As to December, 31st, 2009, EMS had a total capital of 113.800,48 €.

Conclusion: The finances of our society are in very good health and allow us to efficiently propagate our goal – to promote European microscopy.

Christian Schöfer
Treasurer EMS



EUROPEAN MICROSCOPY SOCIETIES

EMS Members of 2010			
Society			*Members Single*
Armenian Electron Microscopy Society	AEMS	Armenia	8
Austrian Society for Electron Microscopy	ASEM	Austria	97
Belgian Society for Microscopy	BVM/SBM	Belgium	212
Croatian Society for Electron Microscopy	CSEM	Croatia	75
Czechoslovak Microscopy Society	CSMS	Czech Republic	237
German Society for Electron Microscopy	DGE	Germany	234
Electron Microscopy and Analysis Group	EMAG	UK	238
Hellenic Electron Microscopy Society	HSEM	Greece	61
Hungarian Society for Microscopy	HSM	Hungary	100
Israel Society for Microscopy	ISM	Israel	106
Microscopical Society of Ireland	MSI	Ireland	63
Dutch Society for Microscopy	NVvM	the Netherlands	386
Polish Society for Microscopy	PTMi	Poland	76
Royal Microscopical Society	RMS	UK	1186
Nordic Microscopy Society	SCANDEM	Norwich	338
Slovene Society for Microscopy	SDM	Slovenia	70
French Microscopy Society	SFμ	France	295
Italian Society of Microscopical Sciences	SISM	Italy	323
Spanish Society for Microscopy	SME	Spain	285
Portuguese Society for Microscopy	SPMicros	Portugal	173
Serbian Society for Electron Microscopy	SSM	Serbia	92
Swiss Society for Optics and Microscopy	SSOM	Switzerland	324
Turkish Society for Microscopy	TEMD	Turkey	122
ECMA			25
Individual members	IND		14

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- SEM-FIB Solutions
- SPI Supplies
- Technoorg Linda
- Thermo Electron
- TESCAN, s.r.o
- Tietz Video and Image Processing
- VSG

EMS CALENDAR 2011

2011 Forthcoming events

- **Winterschool 2011: Practical course in advanced microscopy: EMS sponsored event**
  January 16-21, 2011
  ETH Zurich and University of Zurich, Switzerland

- **Focus on Microscopy (FOM2011): EMS patronaged event**
  April 17-20, 2011
  Konstanz University, Konstanz, Germany

- **Cell Cycle Cancer and Development: EMS sponsored event**
  May 25-28, 2011
  Palais du Grand Large, Saint Malo, France

- **45th ISM annual meeting: EMS sponsored event**
  May 25-26, 2011
  Hagoshrim - Kibbutz, Israel

- **43 Erice crystallographic course: "Electron crystallography": EMS sponsored event**
  June 2-12, 2011
  Ettore Majorana Centre, Erice, Italy

- **The XIVth International Conference on Electron Microscopy: EMS sponsored event**
  June 26-30, 2011
  Wisla, Poland

EMS CALENDAR 2011 - 2012

- **Microscopy Conference MC 2011: EMS Extension**
  August 28 - September 2, 2011
  Kiel, Germany

- **10th Multinational Congress on Microscopy (MCM 2011): EMS Extension**
  September 4-9, 2011
  Urbino, Italy

2012

- **15th European Microscopy Congress, EMC 2012**
  September 16-21, 2012
  Manchester, Manchester Central, UK

A complete calendar can be found at http://www.eurmicsoc.org/events.html

Notes :

APPLICATION FOR MEMBERSHIP

APPLICATION FOR MEMBERSHIP

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 return the following form to :

Prof Dr D. Schryvers, EMAT, Dept of Physics, University of Antwerp
Groenenborger Campus, Groenenborgerlaan 171, B-2020 ANTWERP (Belgium)
Fax: +32 3 265.33.18

Family name: .....

First (given) name: .....

Full postal address: .....

.....

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Notes :

EUROPEAN CORPORATE MICROSCOPY ASSEMBLY (ECMA)

Subscription form

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Nick Schryvers, Secretary EMS, University of Antwerp, CGB, Groenenborgerlaan 171, B-2020, Belgium, fax +32 (0)3 2653 318

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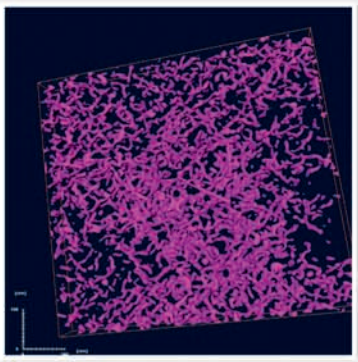
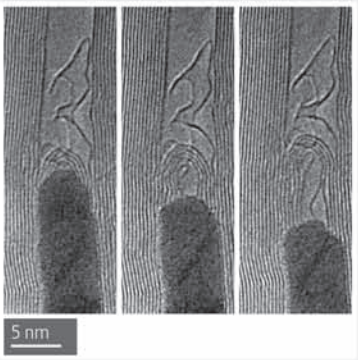


Electron tomography enables 3D visualization of nanonetworks, such as this polymer solar cell material

Courtesy of
Joachim Loos, Eindhoven University of Technology, Netherlands

3D NanoCharacterization

discover down to the atomic scale

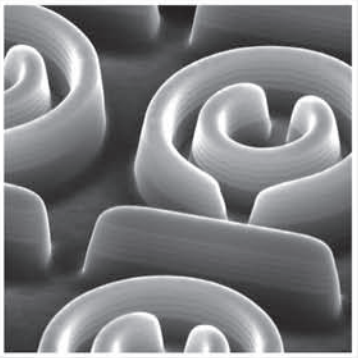


Materials confined within nanotubes provide an *in situ* atomic scale chemical reaction chamber in the TEM

Courtesy of
Julio A. Rodriguez-Manzo, and Mauricio Terrones, IPICyT, Mexico
Florian Banhart, Universitaet Mainz, Germany

in situ NanoProcesses

experiment down to the atomic scale



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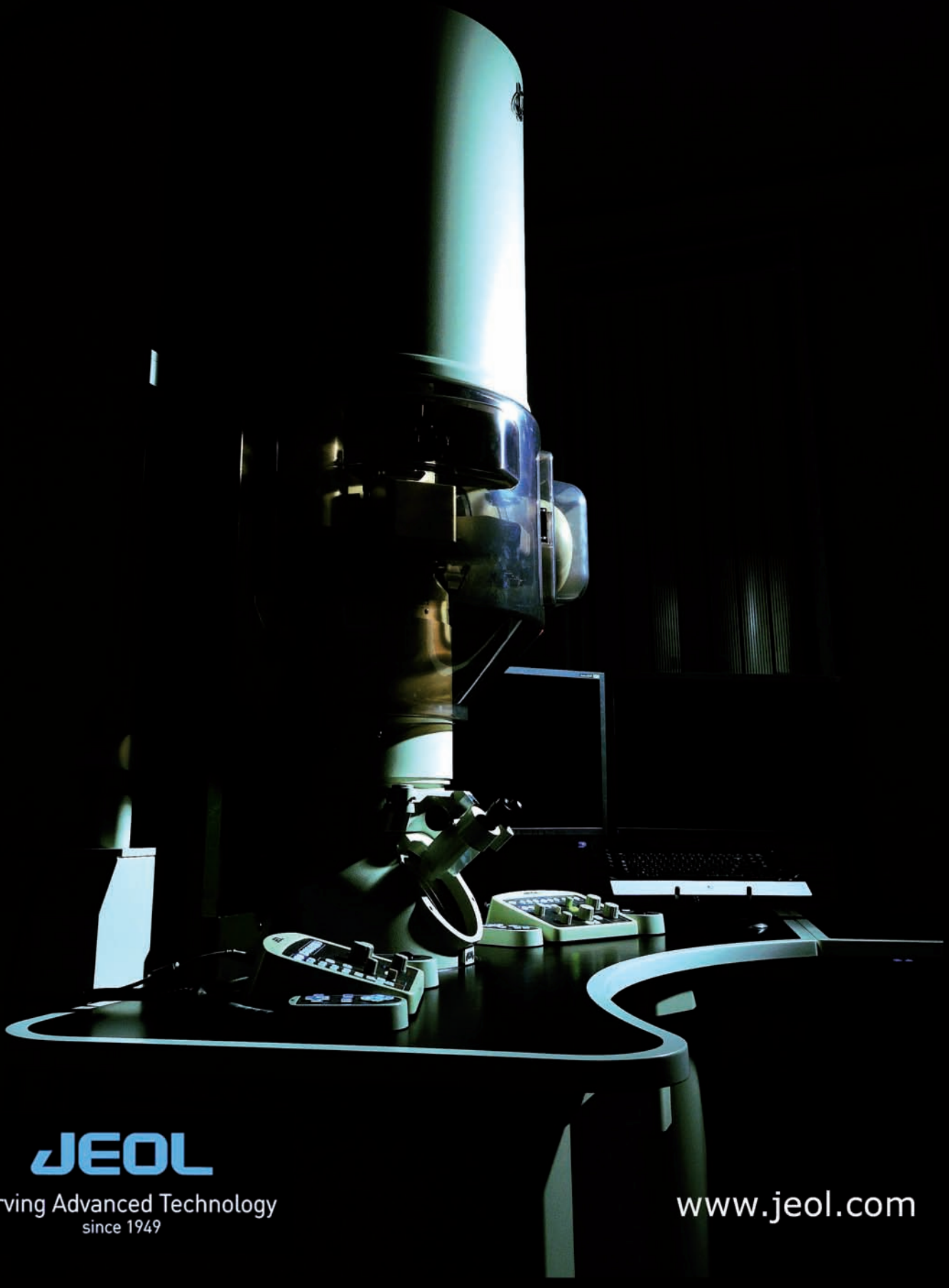

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