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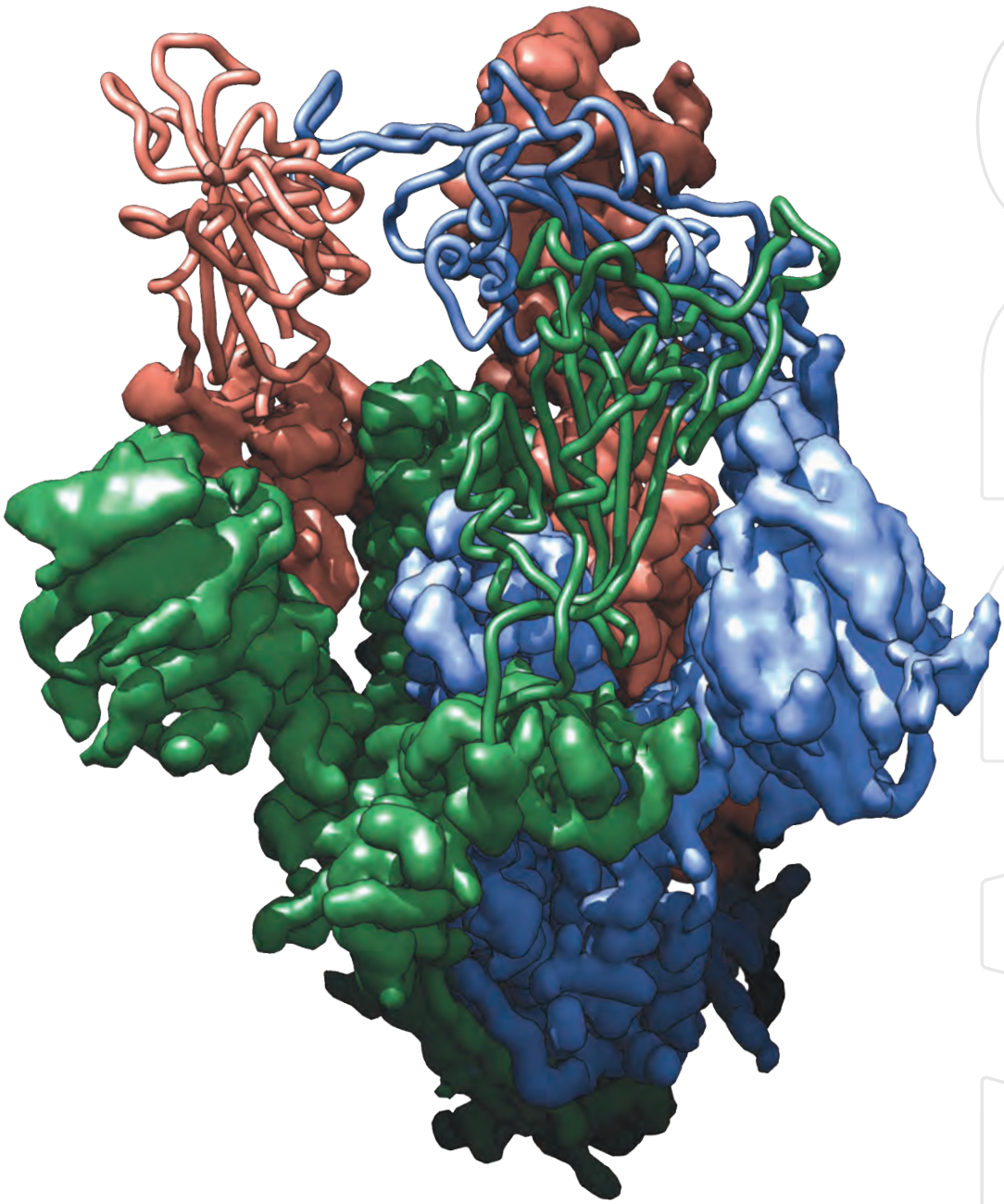

YEARBOOK 2021

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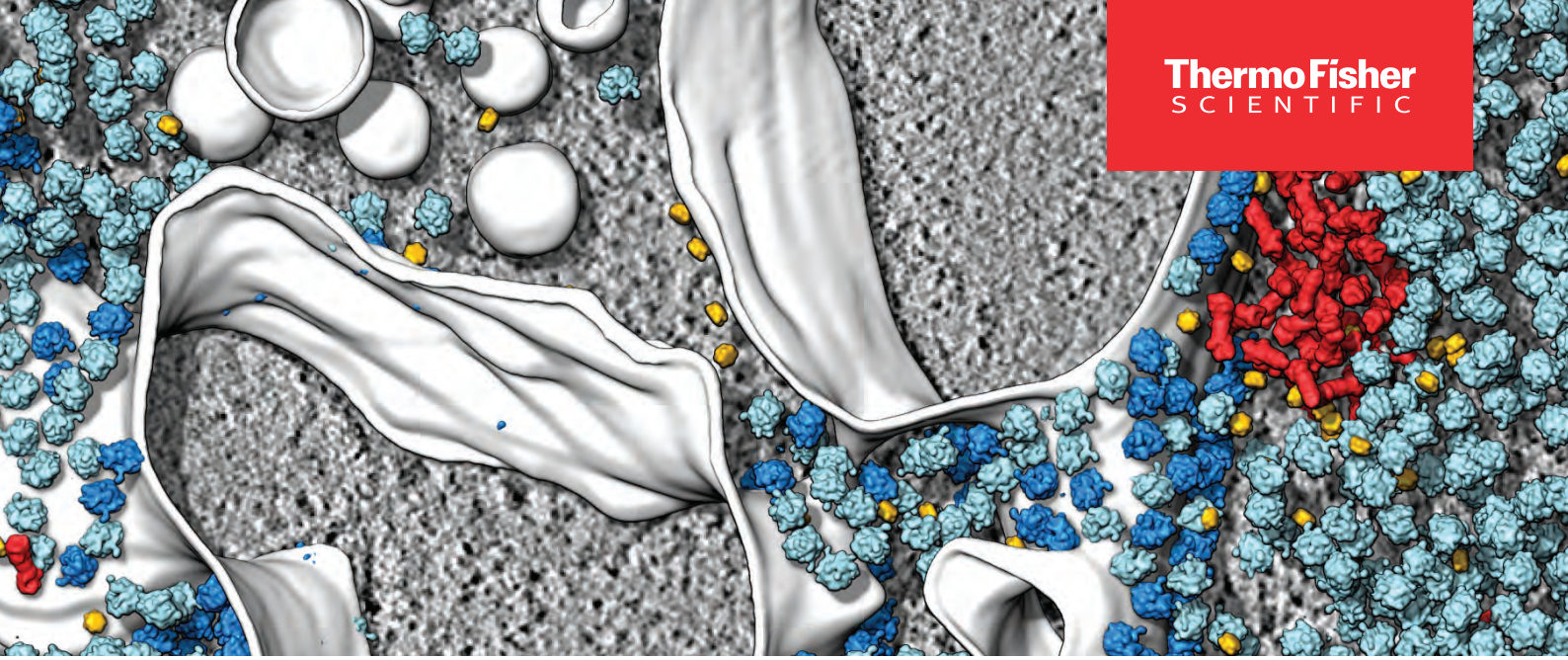

Phase-separated protein degradation microcompartment where proteasomes (red) cluster at the endoplasmic reticulum membrane.

Resolve protein structures inside cells with cryo-tomography

Cellular cryo-electron tomography (cryo-ET) is a label-free cryogenic imaging technique that generates 3D datasets of organelles and protein complexes at nanometer resolution.

Now, you can reliably prepare sample cryo-lamellas faster through automation. The **Thermo Scientific™ Aquilos™ 2 Cryo-Focused Ion Beam (Cryo-FIB)** allows you to automate the production of multiple lamellas from specific programmed locations.

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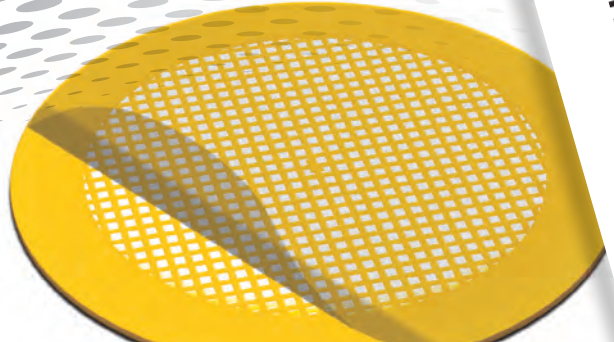

Electron Microscopy Sciences

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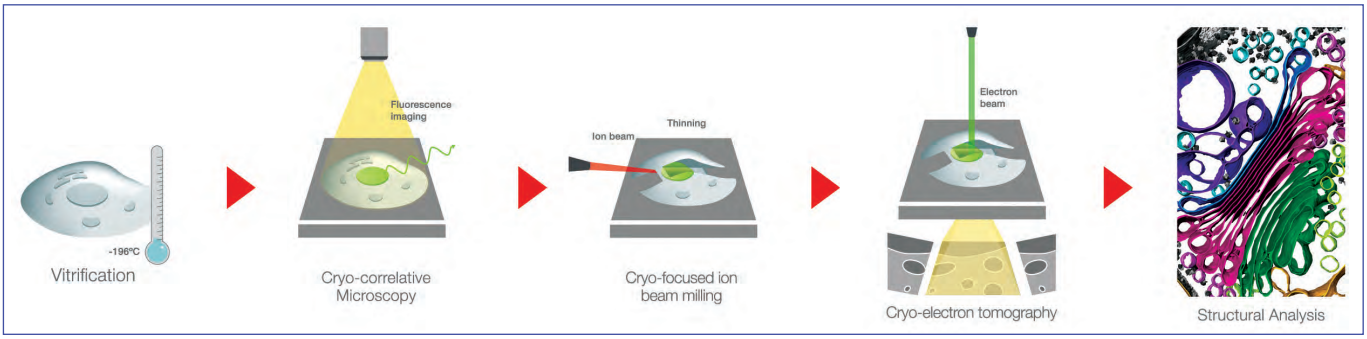
INSIDE THE CELL WITH CRYO-ELECTRON TOMOGRAPHY



What is cryo-electron microscopy?

Biological systems are enormously complex, and it is becoming increasingly clear that we need a full, multi-scale understanding of these structures in order to advance life sciences research. Cryo-electron microscopy (cryo-EM) describes a range of techniques that allow such systems (i.e., small molecules, proteins, and even cells) to be observed in their near-native states. By rapidly freezing samples at cryogenic temperatures, cryo-EM eliminates the need for crystallization, which is otherwise necessary for hallmark structural analysis techniques such as X-ray crystallography.

With cryo-EM, 3D protein structures can be determined to near-atomic resolution, allowing us to understand how they work, their role in disease, and how they'll respond to therapies. Cryo-EM has become the go-to method for scientists around the world, generating breakthroughs in the research of infectious and neurodegenerative diseases, cancer, and more.

Insights from **Prof. Florian Schur**

PhD, Institute of Science and Technology Austria

Florian Schur's group at the Institute of Science and Technology Austria is investigating the structural biology of cell migration and viral infection. They use cryo-ET to visualize these processes and then supplement and contextualize this information with cell biology and biochemistry. Using this multi-technique approach, they have captured the assembly mechanisms of viral particles such as retroviruses or other large DNA viruses.

"One of the great promises of cryo-electron tomography is that it allows you to visualize molecules that are present in a cell at a given time and how they might interact with each other.

This essentially represents the greatest advantage of cryo-electron tomography, which is visualizing proteins in their native environment. If I'm interested in one protein, I'm not only observing this single protein, but all of its interaction partners that are there at the same time, potentially extending our understanding into a functional domain rather than just a structural domain."

Florian Shur, PhD, Institute of Science and Technology Austria

What is cryo-electron tomography?

Cellular cryo-electron tomography (cryo-ET) is a label-free cryogenic imaging technique that provides 3D datasets of organelles and protein complexes at nanometer resolution. This is done by opening windows into a cryogenically frozen (vitrified) cell with focused ion beam (FIB) milling. A series of 2D images is taken of this thinned cellular sample (cryo-lamella) and then reconstructed into a 3D dataset.

Cryo-ET sample preparation

While cryo-ET can visualize protein complexes within their native cellular environment, most cells are too thick to be imaged directly by transmission electron microscopy (TEM), requiring cryo-FIB milling to thin the samples.

This method faces an additional challenge when dealing with tissues and multicellular organisms, as these samples must be high-pressure frozen (HPF), which embeds the sample in a thick layer of ice.

Cryo-EM has become the go-to method for scientists around the world.

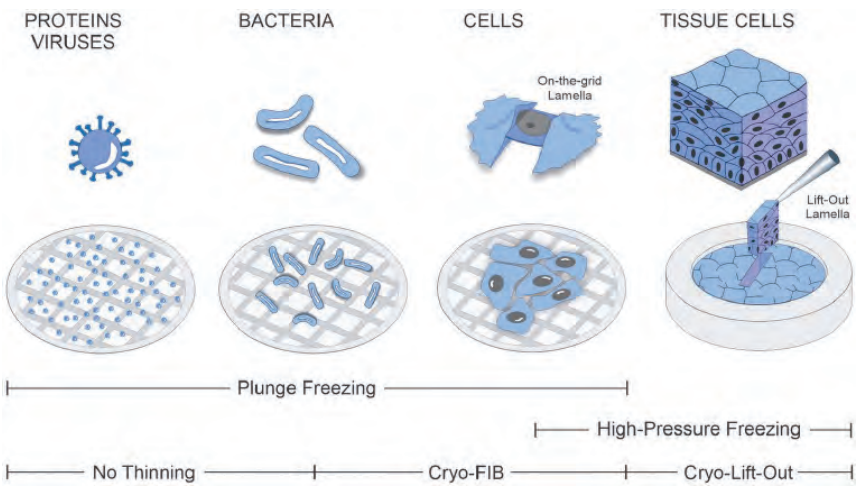
Nonetheless, lamellae can still be prepared from such samples by first extracting a small volume and transferring it to a receiver grid for subsequent lamella preparation, a process called lift-out.

Cryo-FIB milling and lift-out

Sample thinning is performed in cryo-FIB scanning electron microscopes (also called FIB-SEMs), which use the ion beam to remove frozen cellular material while monitoring sample conditions with SEM. Electron-transparent cryo-lamellae are prepared from vitrified cells by ablating material above and below a target region. Tomography of cryo-FIB-milled samples has provided unprecedented insight into the native ultrastructure of unicellular organisms and cells cultured on 2D supports, shedding light on cellular phenomena and molecular complexes.

As organoids, small organisms, and tissue biopsies are too thick for plunge-freezing, they must instead be prepared by HPF. Such samples can no longer be thinned using on-the-grid lamella preparation methods. Instead, a lift-out technique is used: the area of interest is first extracted from the bulk and then thinned into a lamella. This approach expands the applications of cryo-ET, enabling the investigation of tissues and whole organisms in situ at molecular resolution.

The range of biological samples accessible for cryo-ET and their associated freezing and preparation methods are summarized in box 1. ■



Box 1. *Range of biological specimens compatible with cryo-ET with corresponding freezing and thinning procedures.*

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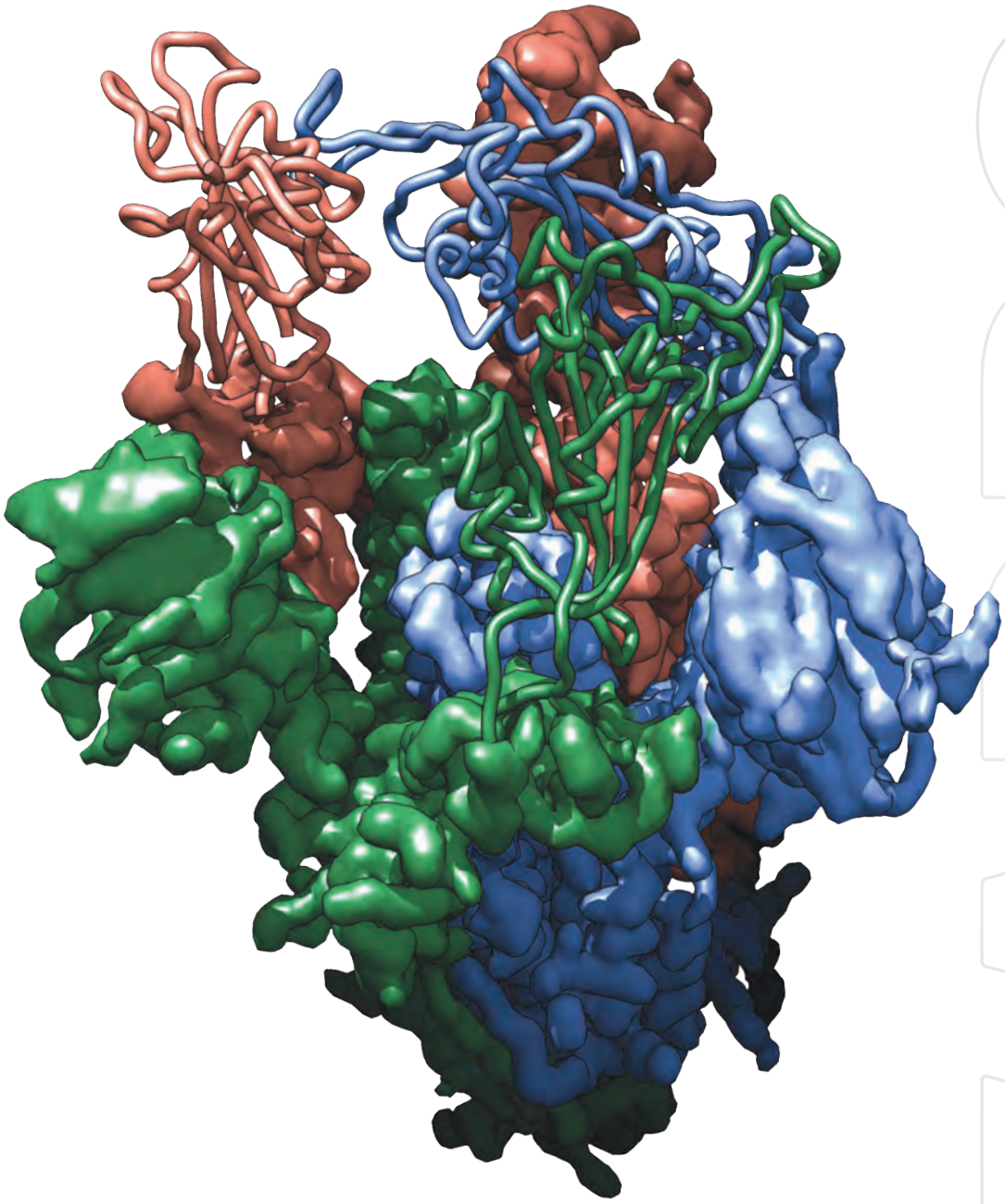

YEARBOOK 2021

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Preface

Dear EMS members,

It is our great pleasure to send you the 2021 EMS yearbook.

We see the light and the end of this period of worldwide health. It will soon be time for face-to-face meetings and reconnecting with our habits in the community.

In 2021, our community continued its dense activity. This yearbook, which contains a lot of information, will surely convince you about our society's excellent health and dynamism. In particular, look at the paper from José-María Carazo about the Covid19, and the very kind obits of Peter Hawkes about Prof. Zeitler and Prof. Spence, who died last year. In addition, I like the new section I launched some years ago with the year reports of national societies.

In early April 2021, the EMS Executive Board met virtually to set the current points, extension, IMC, financial, events, and the starting preparation of EMC in 2024 in Copenhagen.

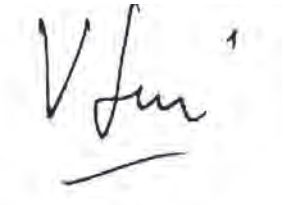
At the beginning of 2021, the EMS Outstanding Paper Award jury decided on the round of 2020. Twenty-one high-quality papers were nominated, more precisely: 4 Instrumentation and Technique Development papers, 8 Life Sciences papers, and 5 Materials Sciences papers. The following were selected as award winners: D. Mahecic et al., Nature methods. (Instrumentation), G. Wolff et al., Science (Life Sciences), and M.U. Rothmann et al., Science (Materials Sciences). Congratulations to the authors of these outstanding papers! We also warmly thank all other exceptional papers nominators and look forward to a new round by next January 2022 for the 2021 papers. The EMS expresses gratitude to the brilliant jury Miran Ceh (Jožef Stefan Institute, Ljubljana, Slovenia), Ute Kaiser (University of Ulm, Ulm, Germany), Peter Nellist (Oxford University, Oxford, UK), Florian Schur (IST Austria, Klosterneuburg, Austria), Iva Tolic (Ruđer Bošković Institute, Zagreb, Croatia), Maria Varela (Oak Ridge National Laboratory & University Complutense of Madrid, Madrid, Spain), and the chair Randi Holmestad. The awards were delivered during the virtual GA held during the EMS extension, Joint Meeting of Dreiländertagung & Multinational Congress on Microscopy, in August 2021.

In 2021, 4 events were sponsored by the EMS, and motivating reports are available in this yearbook. Microscopy at the Frontiers of Science, 27 to 30 September 2021, Virtual Meeting; Combined fit-4nano and EU-F-N workshop 2021, 27 to 29 September 2021, Vienna – Austria; Single Molecule Localization Microscopy Symposium, 31 August to 02 September 2021, Lausanne – Switzerland; and Scandem 2022- The 72nd Annual Meeting of the Nordic Microscopy Society, 17 June 2021, Online

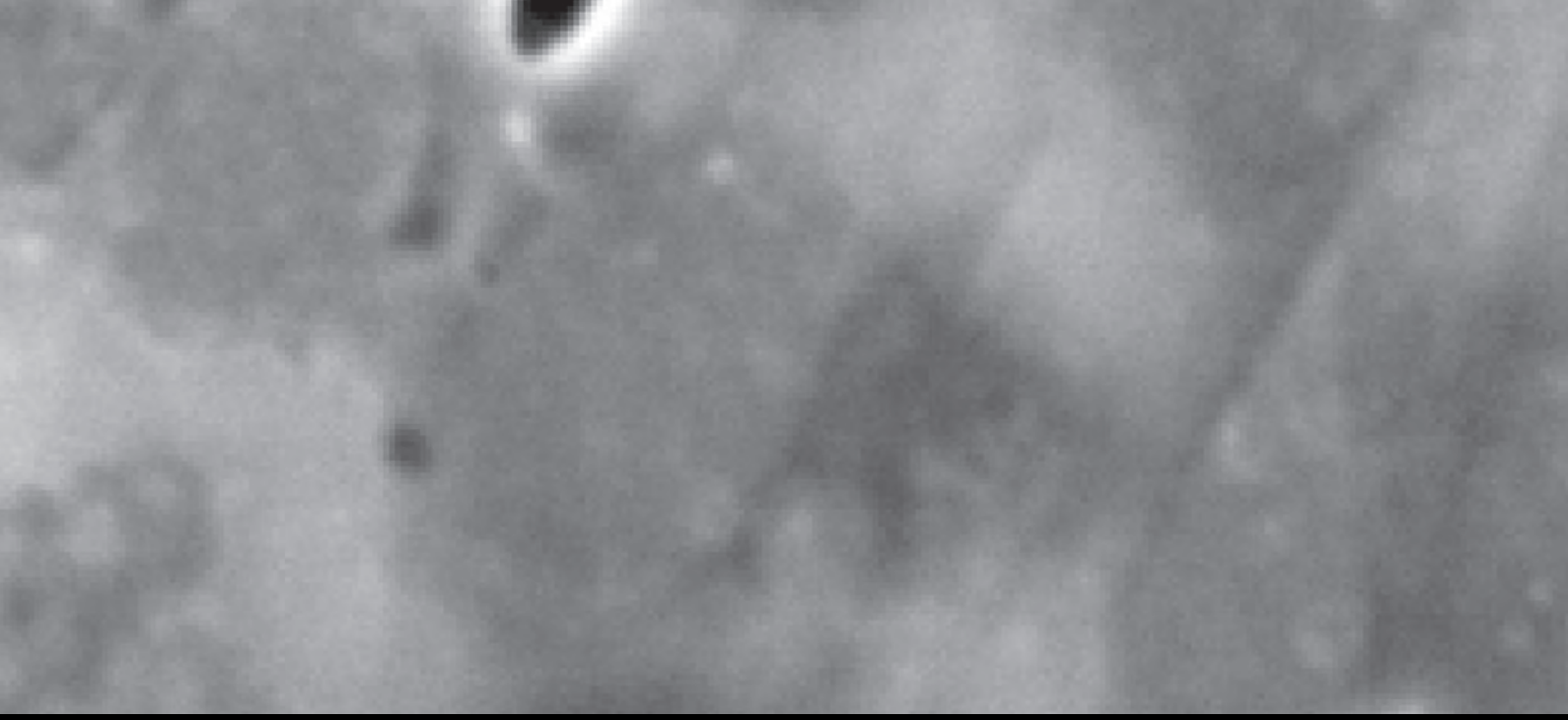
This 2021 EMS yearbook is printed and distributed by the ERI company, free of charge for society. Special thanks to the firms advertised on its pages to support us.

Thanks to all our colleagues who have contributed to and helped proofread this yearbook.

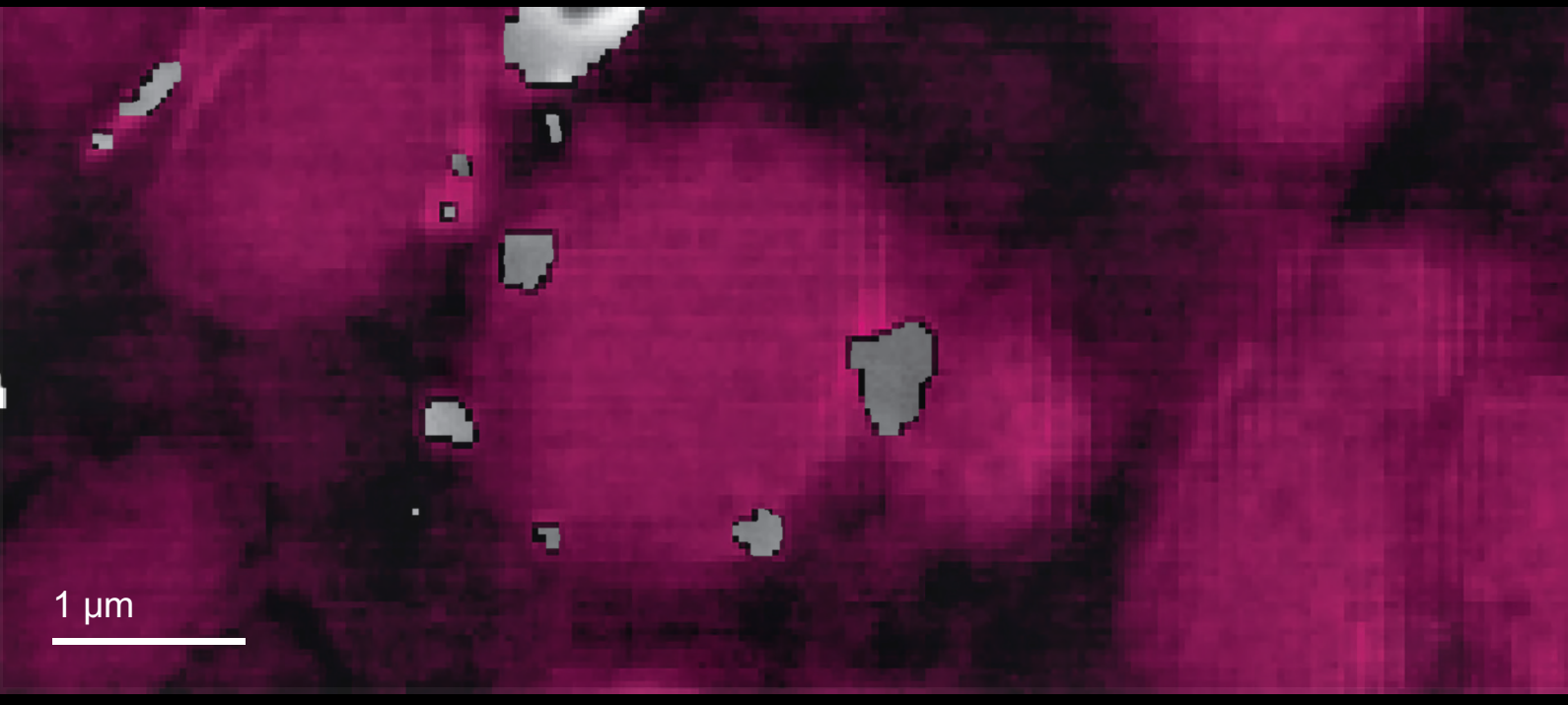
We look forward to new developments, announcements, and a fascinating time at the two EMS extensions of 2022 PICO and the 16th Multinational Congress on Microscopy (MCM16).



Virginie Serin
EMS Secretary



Recharge Your Lithium Research



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Enabling quantitative mapping of lithium in the SEM

For the first time, lithium distribution in a lightweight MgLiAl structural alloy is mapped in the scanning electron microscope. Using the Octane Elite Super (EDAX) and OnPoint™ (Gatan) detectors, the composition by difference method was used to reveal the distribution of single-digit mass percentages of lithium quantitatively across the macro-, micro- and nano-scales.

See www.gatan.com/lithium for the full experiment brief.

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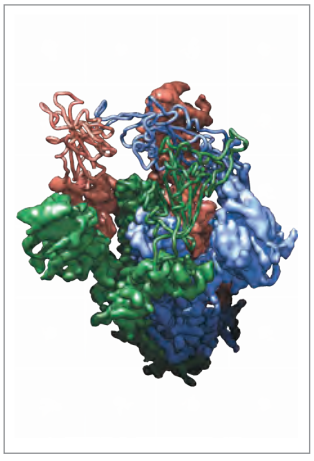
Yearbook 2021 - Contents

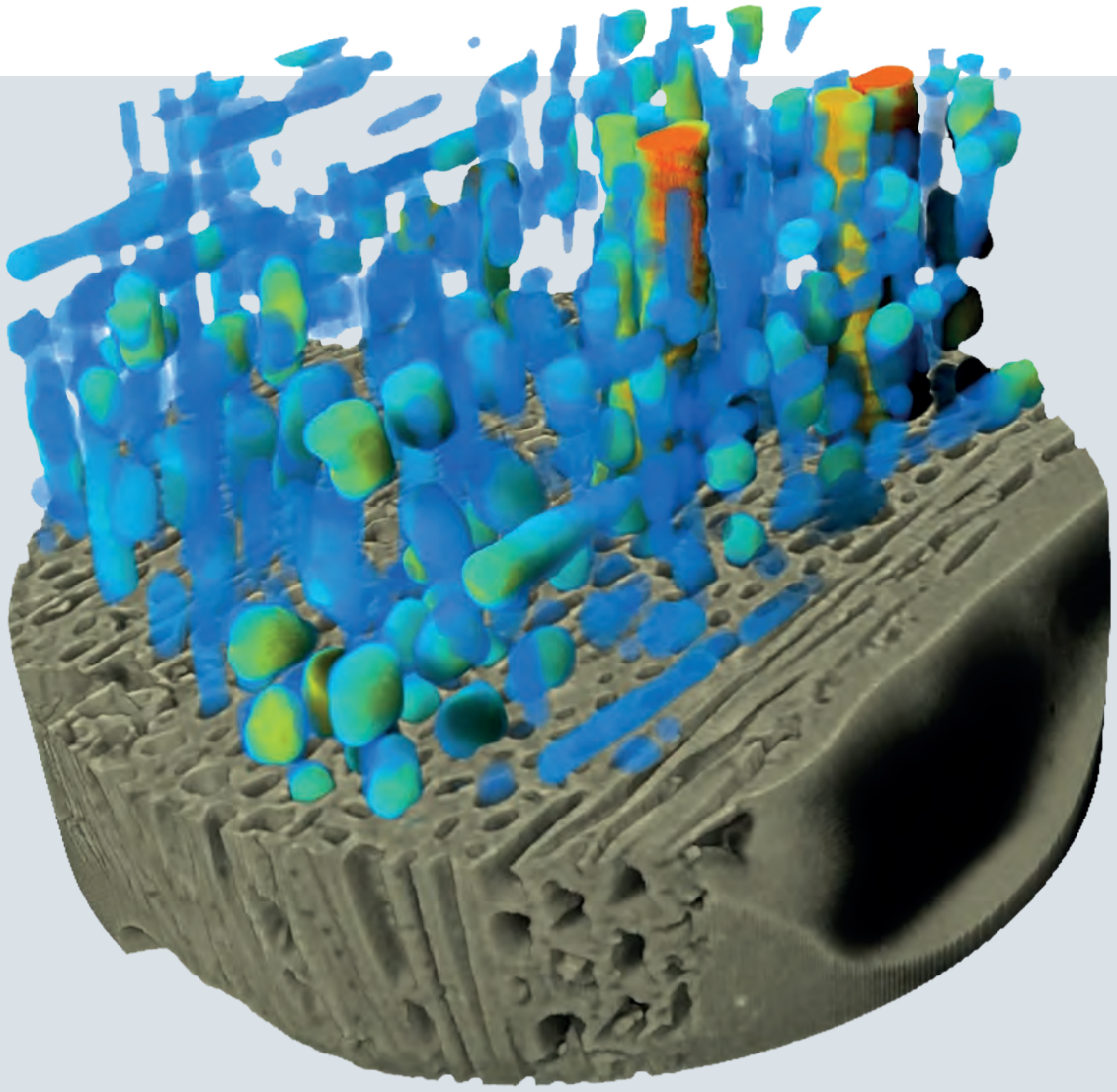


Three-dimensional reconstruction of the SARS-CoV-2 Spike protein trimer obtained by cryo-electron microscopy single-particle analysis at 3.2 Å resolution.

Each spike protein monomer is coloured differently (red, blue and green) and depicted in surface representation. The Receptor-Binding Domain (RBD) part is rendered as ribbon diagrams.

The RBD of the red monomer presents the upwards conformation, necessary for the virus to recognize the Angiotensin-Converting Enzyme 2 (ACE2) receptor in the host.

TESCAN



Wood sample scanned at 280 nm voxel size - vessels are color-coded to thickness.

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Letter from President

Dear EMS members,

The EMS yearbook 2021 that you are perusing contains a summary of the activities of the EMS national societies and their members. As you can see, many events took place last year that show our Society's resilience in the face of the COVID19 situation. Our community has not only endured the ravages of the virus but has made an essential contribution to understanding its structure and functional cycle. José María Carazo's article summarises some of the achievements made by cryoelectron microscopy in understanding the virus infection mechanism. The paper is yet another proof of the revolution that has taken place in structural biology with the technical developments associated with cryoelectron microscopy, which is maturing into a technique as powerful as X-ray diffraction.

During 2021, although most of the activities (meetings, workshops, courses) of the European actions have remained virtual, some on-site meetings point to 2022 as a return to normality. The EMS has maintained the support of many of these activities, and you will find a summary of them on these pages.

One of the duties of our Society is to support excellence, which we do by organizing the annual Outstanding Paper Awards (OPA) in the three disciplines (Materials Sciences, Life Sciences, and instrumentation and Technique Development). Our board member Prof. Randi Holmestad coordinated this activity, to whom we should be grateful. Our EMS secretary, Prof. Virginie Serin, has already given an overview of these awards, and you will find more information on these pages.

A core aspect of EMS activities is the support from meetings and workshops organized by EMS members, including scholarships for young scientists. You will find information reports on these events funded by money received from our members and corporate sponsors. The funds used by the EMS for this and other activities are in the hands of our competent treasurer, Prof. Christian Schoefer, and you can check on these pages the accounts of our Society.

Times are changing, and EMS must adapt to them. Thus, the website is being updated, thanks to the work of our board member Prof. Lucy Collinson, whom we must thank for her efforts. The web page will soon be made public, and we would like to hear your feedback.

EMS support and organizational activities are monitored through biannual meetings, which this year were held virtually in May and September. I would like to thank the members of the EMS board for their continuous support but in particular, the work of the EMS secretary (Prof. Serin) and the treasurer (Prof. Schoefer), who are the heart of this Society. A special thanks must go out to all our sponsors, which are not only active in assisting the scientific activities of EMS members but also support each meeting and workshop, and who have made it possible that this yearbook reaches you free of cost.

Other special thanks go to Prof. Servet Turan and the EMS PCO liaison, Marina Vita, for coordinating this yearbook, which summarises the work of a very active community representing more than 24 national societies.

Finally, I would like to have a special remembrance for the members of the EMS who have left us in the past year and who have contributed to the development of the disciplines that the EMS represents. A special tribute goes to Prof. Zeitler and Prof. Spence.

I look forward to seeing you at some of the activities that the year 2022 has in store for us.

José M. Valpuesta
EMS President

EMC2024

Report 2024

August 26-30, 2024; Copenhagen, Denmark

Emc2024, the forthcoming European Microscopy Congress, is hosted by Scandem – The Nordic Microscopy Society – and will take place at The Bella Center, Copenhagen (Denmark) on August 26-30, 2024. Preparations are well underway both scientifically and locally.

emc2024 will be a physical conference with 6-7 parallel scientific sessions embedding 3 major symposia: Life Science, Physical Science, and Instrumentation & Methodologies headed by Eija Jokitalo (Helsinki, FI); Jakob Birkedal Wagner (Copenhagen, DK); Julia Fernandez-Rodriguez (Gothenburg, SE); and Randi Holmestad (Trondheim, NO), respectively.

The emc exhibitions typically attract over 100 exhibitors, ranging from small start-up companies to industry giants. This makes it an excellent opportunity to compare the latest products from different suppliers with many product demonstrations available. In addition, company teams on hand will offer advice for any challenges you may have at the lab and answer any questions you may have.

Courtesy of Giuseppe Liverino, Copenhagen Media Center

Oliver Sperling, Copenhagen Media Center

Set to be the largest of its kind in Europe, the emc2024 exhibition will also offer several free commercial training workshops throughout the hall focusing on the latest equipment and software. The workshops will be presented by industry experts offering you trouble-shooting tips and handy tricks you can take back to your workplace.

The exhibition at emc2024 – encompassing an area of approximately 2200 m^2 – will be the central hub for the entire event, including the plenary lecture theater, 5-6 break-away lecture theaters, digital posters, workshops, and catering. In addition, it will provide an outstanding opportunity for networking for both delegates and exhibitors.

Please visit **www.emc2024.eu** for more information and updates.

On behalf of these societies and the Organizing Committee, I look forward to welcoming you to Copenhagen for what promises to be a real great event. ■

Professor Klaus Qvortrup
Conference chair

Courtesy of Daniel Rasmussen, Copenhagen Media Center

The MultiPrep™ System

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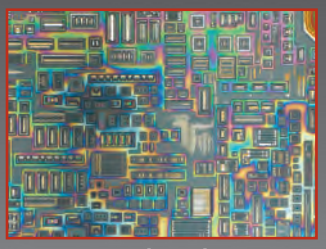
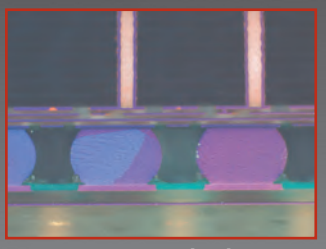
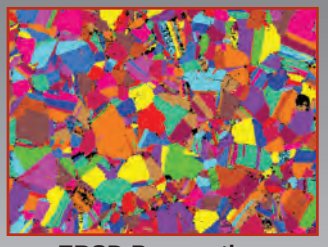
Common applications include parallel circuit delayering, cross-sectioning, substrate thinning, serial/3-D preparation, wedge polishing and more.



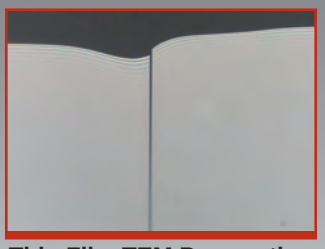
IC Delayering



Cross-Sectioning



EBSD Preparation



Thin Film TEM Preparation

Unequalled Sample Preparation Results

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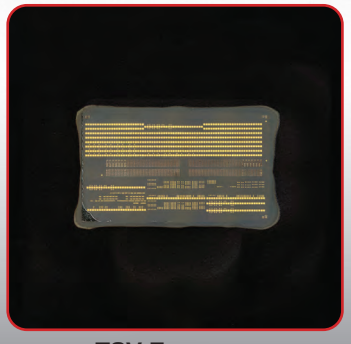
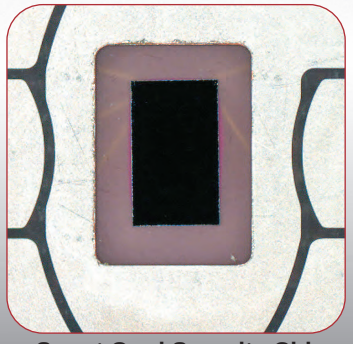
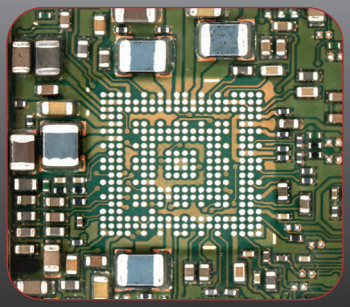


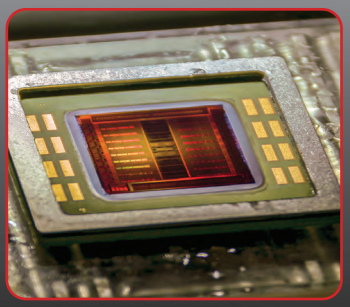
TSV Exposure



Smart Card Security Chip Exposure



Mobile Phone Chip-Off Component Removal



Uniform silicon thinning to less than 2 µm

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TESTING INSTRUMENTATION IN THE NANO AND MICRO SCALE BY SCHAEFER-TEC

The Schaefer-Tec group with offices in Germany, Switzerland, France, Italy and Romania is a European distributor and service provider for a number of scientific testing instruments. Schaefer-Tec has been founded over 50 years ago, originally with vacuum technology, and has evolved over time to include instruments for nano- and microtechnology respectively surface analysis. The following interview has been made with the CEO, Martin Bossard.

Which are today your main product lines?

We see a strong demand for advanced **optical and mechanical 3D profilometry** which we cover with products from our partners KLA (Zeta), GBS and Sensofar. Optical 3D profilers allow the form and roughness measurement of surfaces with features down to sub-micrometer lateral dimensions and structure heights down to nanometres. The Zeta-300 optical profiler for example has the possibility of automatic wafer handling while other models offer five-axis sample handling for 360° stitching, or fast analysis for in-line inspection.

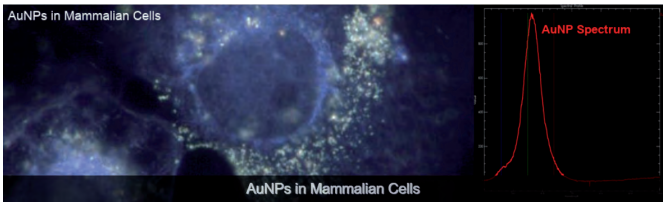
Another important line are the **Nanoindenters** respectively **Nanomechanical testers** from KLA. They provide reliable measurements of hardness, Young's modulus, and other mechanical properties at the surface to explore new materials and reduce product failures. The large range of models include frequency-specific testing, quantitative scratch and wear testing, integrated probe-based imaging, high-temperature testing, in-SEM use and many more.

Are you also selling high resolution microscopes?

We are representing **AFM's** (RHK, for UHV AFM/STM as well as CSI which is particularly strong in electrical measurements) as well as **SEM's** (Phenom desktop SEM's).

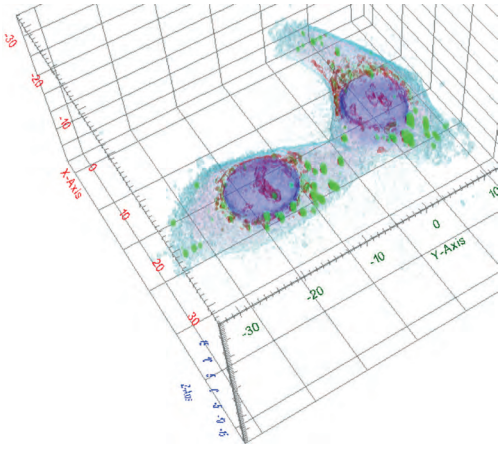
You mentioned nanotechnology, which products do you have in that field?

Besides the AFM's which were already mentioned we offer instruments for the detection and qualification of **nanoparticles**. For example the CytoViva label-free detection and identification of nanoparticles in cells or tissue by the patented **Enhanced Darkfield Hyperspectral Microscopy.** For precise size distribution measurement of nanoparticles, we propose the LS Instruments laser light scattering instruments.



That means you are also working in biological systems?

Yes, besides CytoViva we also represent a new **Holotomographic (3D holographic) microscopy** technology from Tomocube which enables the quantitative and noninvasive investigation of biological cells and thin tissues. The Tomocube microscope reconstructs the 3D refractive index distribution of live cells and by doing so, provides structural and chemical information about the cell including dry mass, morphology and dynamics of the cellular membrane.



Is there a "last but not least" field we have not covered yet?

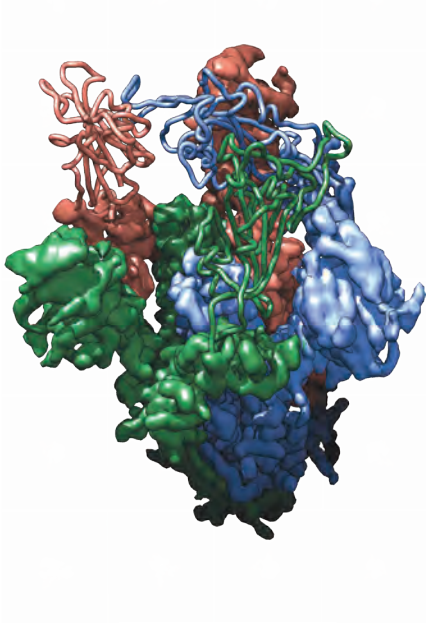
There are a few, but I would like to mention the **Micro- and Nano-Probing Robots** (Imina) for Nano-probing and -manipulation inside a SEM, FIB or under an optical Microscope with unsurpassed precision, as well as **Cryostats** (ARS Cryo).

Covid 19 by José María Carazo, Invited Contribution

COVID19

The pandemic whose images we could follow by cryo Electron Microscopy

COVID19 has been disrupting our lives for the last two years already. It is, therefore, natural that we seek to understand its nature and design effective countermeasures. COVID19 is caused by SARS-CoV-2, a virus of around 100 nanometers in diameter. To better understand this virus, the scientific community has put forth a great deal of effort in trying to elucidate its atomic structure. Fortunately, cryogenic electron microscopy (cryoEM) was ready to meet this challenge.



The relevance of the field of cryoEM was recognized about 5 years ago, when the Nobel Prize in Chemistry was awarded to the pioneers in the field, after less than a decade had passed since the beginning of the so-called cryoEM "Resolution Revolution." Powered by its ever-growing resolution capabilities, cryoEM experts across the globe began elucidating the structure of SARS-CoV-2 itself and many of its proteins, unrevealing the subtle molecular interactions that characterize them.

In this short communication, we aim to outline not only the precise contribution of cryoEM to our understanding of SARS-CoV-2, but also to critically analyze the way our understanding of open science has evolved during the pandemic. This multifaceted story conforms to our current reality; understanding it in depth is the first step towards better dealing with possible future threats.

The early warnings and the early knowledge we had

SARS-CoV-2 is undoubtedly a new virus but not a complete unknown. SARS-CoV-2 belongs to the general class of Sarbecoviruses, which share similar characteristics. Indeed, a few years earlier, regional pandemics had confronted us with similar viruses (Walls et al., 2017; Kirchdoerfer et al., 2018). During these previous outbreaks of SARS-CoV-2, researchers obtained the first cryoEM images and structural maps of these viruses. These high-resolution images allowed them to identify the key protein for the virus to enter the cell, which is called the infective viral spike. This spike is confirmed by a homotrimer of protein S, and its location at the periphery of the virus allows it to identify cell receptors, triggering infection ***(Figure 1)***. By March 2021, this early knowledge had quickly expanded to include several cryoEM maps of the "new" virus's spike. It was this early knowledge that made it possible for the scientific community to quickly have the first genomic construct suitable for stable and large-scale protein production in March 2020. This knowledge allowed the fast development of the first vaccines targeting the spike.

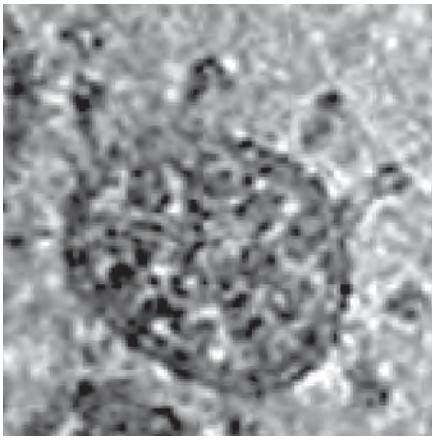


Fig 1: SARS CoV2 micrograph showing the spikes in the periphery of the virus and the complex internal structure of the virus (EMPIAR 10453, from Turonova et al, 2020).

> ***"The natural question was: what is the structure of the mutant spike? How is it different from the wild type one? CryoEM was the natural technique to use."***

The world under lockdown, and the appearance of the first variants

The first weeks of March 2020 seemed to feature scenes from a famous old science fiction movie: The day the Earth stood still. Except it wasn't fiction. Lockdowns extended all over the world as a first reaction to control

the pandemic. Millions of people were infected and, quite naturally, the virus evolved. In many countries around Europe (including my own country, Spain) a certain mutation of SARS-CoV-2 soon became prevalent, the so-called 20A.EU1 variant (Hodcroft et al.,2020). This variant is characterized by a mutation at aminoacid 222 of the spike, normally abbreviated to S:A222V.

Interestingly, this early mutation recently reappeared in the genetic background of the so-called Delta variant (see ***Figure 2***). The natural question then was: What is the structure of the mutant spike? How is it different from the wild type one? CryoEM was the natural technique to use, and this is precisely how we approached this question (Ginex et al., 2021). ***Figure 3*** shows the cryoEM map of the mutant S:A222V, presenting a characteristic spike architecture in which one of the protein domains involved in cellular interaction is pointing up. Further molecular dynamics analysis clearly indicated the existence of pronounced changes in the way this "up movement" occurred, probably facilitating the engagement with the cellular receptor.

As infections continues, new variants appear, like the very recent Omicron Variant of Concern (VOC). The first structural model of the Omicron spike was "twitted" out on December 16th 2021 from Prof. Sriram Subramanian's lab just a few days after the sequence was released. This is an excellent example of how fast and accurate current cryoEM capabilities can be, where, within days, it is possible to go from genetic sequence to protein structure for many samples.

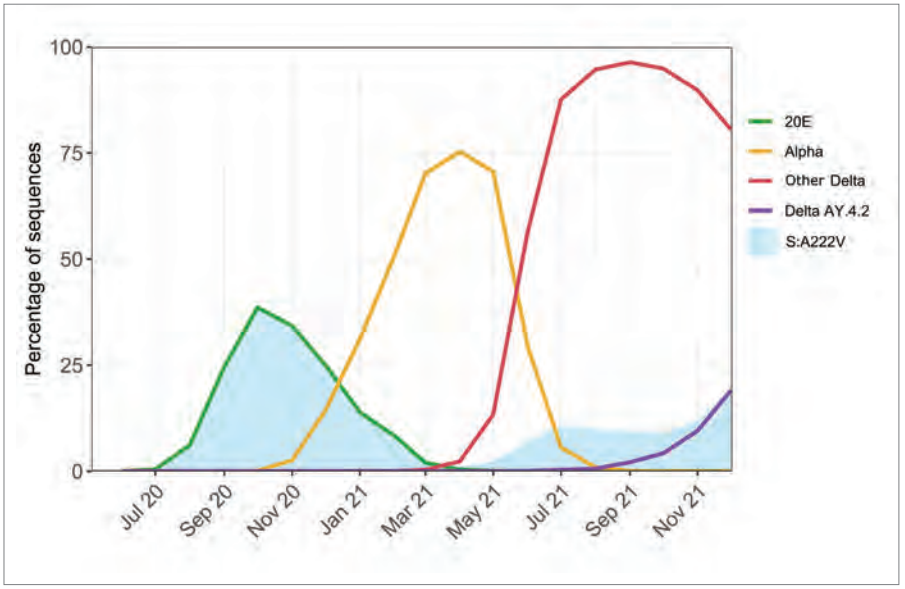


Fig 2: Sequences and epidemiology of 20A.EU1. Figure shows the percentage of viral sequences collected from Covid19 hospital patients with specific viral characteristics. Green and purple curves show the percentage over time of specific variants carrying the S:A222V mutation. The yellow curve depicts the Alpha variant, while the Delta variant is differentiated into those sequences specifically carrying the A222V mutation (referred to as Delta AY.4.2, in purple) and "Other Delta"(in red). Solid blue refers to total percentage of A222V mutations in all variants

The immense cryoEM contribution, an analysis of structural databases

The field of structural biology has always excelled in making recent findings publicly available, at least at the level of structural models. This exemplary situation has allowed us to verifiably quantify the wealth of information on the SARS-CoV-2 virus that the cryoEM field has produced. ***Figure 4*** presents an analysis of SARS-CoV-2 structural models as well as cryoEM maps as they have been reported in different data bases (PDB -Berstein et al., 1977-, EMDB -Lawson et al., 2016- and EMPIAR-Ludin et al.,2016-).

The first outstanding conclusion we can draw from the comparison of the left most and right most columns of ***Figure 4*** is that they are of very similar height! In other words, cryoEM bulk structural contribution to SARS-CoV-2 structural understanding is very similar to that of the far more stablished technique of X-ray crystallography, in spite of being a very young discipline in its capacity to reach atomic resolution. This is a fantastic accomplishment for cryoEM!

Fig 3: cryoEM structure of the S:A222V mutant spike. Bar represents 3 nm.

There are also substantial differences among the types of macromolecules that have been analyzed with each technique. The viral spike, for example, is being mostly analyzed by cryoEM while other, smaller macromolecules, are being mostly studied through X-ray diffraction. Additionally, virtually all binding assays performed by fragment-based screening have been directed against proteins other than the spike, and performed by X-ray diffraction. While all techniques are complementary and should be used in an integrative way, it is worth highlighting, first, the enormous contribution made by the relatively young field of cryoEM during one of the most acute crises the world has gone through in recent times and, second, how this contribution has kept of similar magnitude in 2020 and 2021 ***(Figure 4)***, suggesting that the field of cryoEM has reached a stable level of maturity.

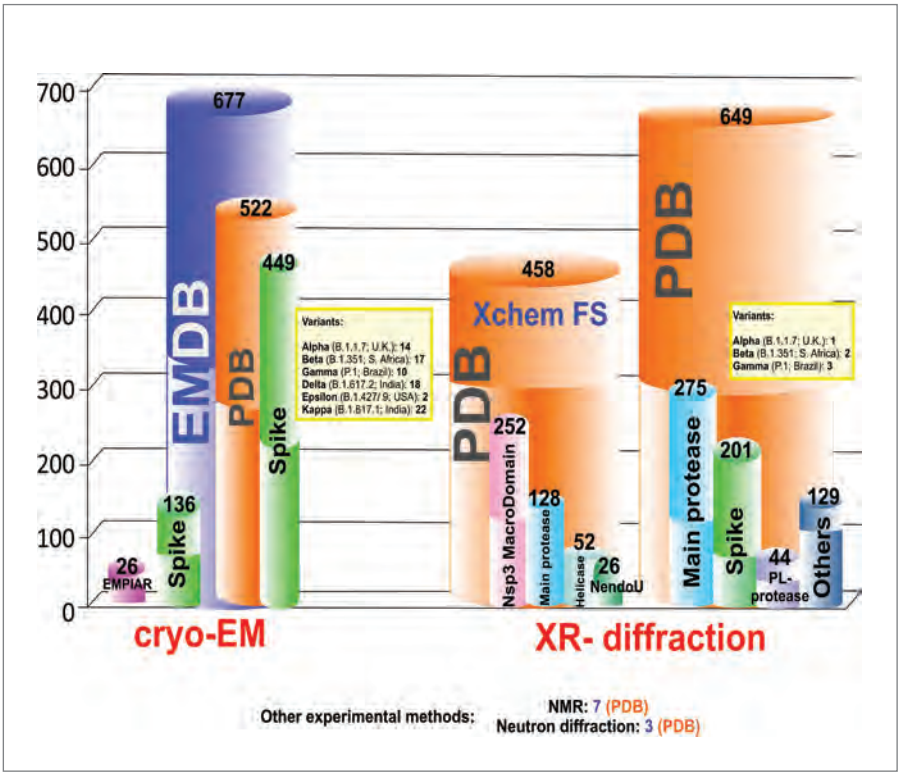


Fig 4: Statistics of EMDB/PDB/EMPIAR submissions (in ordinates, number of cryoEM maps or of structural models), as December 14th 2021. On the left-hand side, cryoEM data depositions. Maps deposited to EMDB are shown in blue, while structural models deposited to PDB are in orange. Depositions of raw data to EMPIAR are indicated by a small purple column at the far left. The two green columns correspond specifically to depositions of spike structures (the small one on the left correspond to tomography data, while the big one on the right correspond to macromolecular data). **On the right-hand side, X-ray diffraction data depositions.** Data from fragment-based screening are differentiated and marked atop as Xchem FS. General X-rays depositions are shown on the right-most column. The small columns show depositions corresponding to specific proteins. We can appreciate two levels of shades in each column; the bottom one corresponds to submissions during 2020, while the upper one during 2021. The number of structures per viral variant is also shown.

Learning from nature, and the structure of complexes with antivirals

The scientific and commercial race towards developing therapeutic agents against SARS-CoV-2 has been truly unprecedented. Some notable winners of this race have been the mRNA vaccines, and the expectation is now with new antiviral medications which are being developed to be delivered upon viral infection.

"It is crucial to have a clear picture of the binding mechanisms presented by the different antibodies. The contribution of cryoEM to this area has been remarkable."

At the root of this effort is an in-depth analysis of how our immune system reacts to the virus. It is therefore crucial to have a clear picture of the binding mechanisms presented by the different antibodies. The contribution of cryo-EM to this area has been remarkable. For example, cryoEM has been able to resolve one of the most striking spike complexes presented to date, which includes the spike in complex with four different antibodies (Sun et al., 2021). The inspection of complexes such as this one helps us to understand which areas of the spike elicit a stronger immune response, as well as the mechanism by which viral neutralization eventually happens.

Once we have gathered the knowledge of what our own immune system does through the use of the above-mentioned techniques, we now have the blueprint to design other agents that also bind to the viral spike. These agents could now present other additional interesting characteristics related to efficient industrial production, enhanced binding or easy drug delivery. A representative set of results obtained by cryoEM on the immunogenic landscape of the spike is presented in ***Figure 6***. In this cartoon we can identify the structure of the spike protein when it is bound to multiple different antibodies. We first note how the part of the spike closer to the cell surface is able to elicit many antibodies (top row of ***Figure 5***). Indeed, we know that this area is responsible for cell receptor recognition and it is actually referred to as "Receptor Binding Domain" (RBD). The existence of many natural antibodies against this region already tells how important immunogenically it is. The second row of

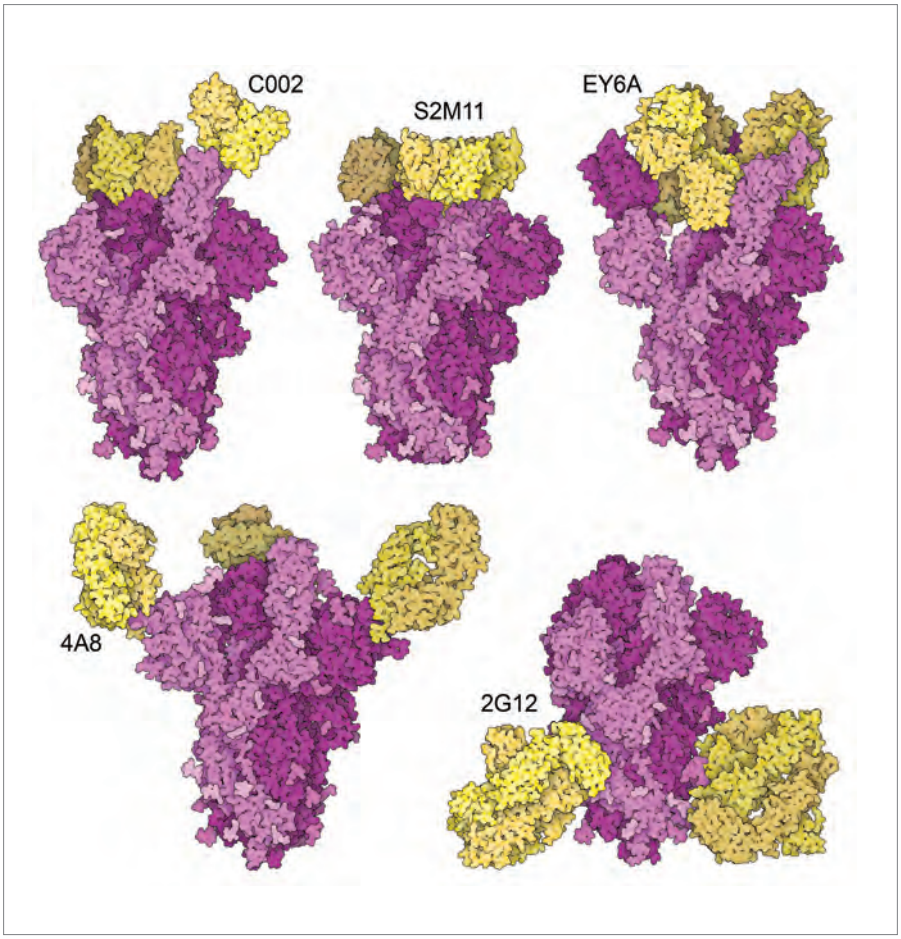


Figure 5 (from (https://pdb101.rcsb.org/motm/256)): **Image taken from the PDB web site.** The trimer of the spike protein is shown in pink and the antibodies to different parts of the spike are marked with its unique identifier and shown in yellow, as solved by cryoEM. Upper part, antibodies against RBD. Lower part, left, antibodies against NTD. Lower part, right, antibodies against S2.

Figure 5 presents, on the left, the 4A8 antibody interacting not with RBD, but with the N-terminal domain (NTD), representing the case of allosteric inhibition in which by disrupting the flexibility between NTD and RBD the capacity of RBD to initiate infection diminishes. Finally, on the right-hand side of the lower part of the figure it is shown the spike bound to an antibody which would be away from the cellular receptor (and, thus, very close to the own capsid of the virus), the so-called S2 region; so far, no neutralizing antibodies against this region have been found for SARS-CoV-2, but it may be critical for yet unknown dynamical aspects of the spike.

In our own work at the CNB-CSIC in Spain we have used "nanobodies", which are relatively simplified antibodies, in order to study how they interact with the spike protein. Using cryoEM, we have been able to resolve macromolecular complexes that have the in vitro capacity to neutralize the virus (work in progress, and ***Figure 6***).

Open science, and how we have not yet learned to share

The pandemic has changed many facets of the world we live in. It has also changed some of the ways we do science. However, it has clearly not changed all habits, especially, our attitude towards sharing raw data.

Before the Covid19 outbreak, approximately only 6% of all cryoEM structural maps being deposited were accompanied by their corresponding raw data ***(Table I)***. Unfortunately, this percentage has remained equally low after the Covid19 pandemic. The conclusion is clear: Not even under the urgency and stress of a viral threat have we learned to share our data. But if we don't share our data under these extreme circumstances, when will we? Data sharing is clearly the way to make sure that the most of information is extracted from data that are very hard (and expensive) to acquire, and it is also the best way to assure the reproducibility of our results. Data sharing is not just a basic pillar of science, but it is a scientific imperative when we are working against the clock to thwart an incoming threat.

When it comes to data sharing, Europe is in a far better position compared to other areas of the world, so that about 16% of all Covid 19-related structural models published in Europe were indeed accompanied by their corresponding raw data. Unfortunately, the percentage of data sharing drops to close to 2% (and even to "zero") in other regions of the world. While this situation is far from ideal, it does reflect how Europe has taken the lead regarding data sharing and, through it, reusability and results validation. These numbers speak highly of the sustained efforts

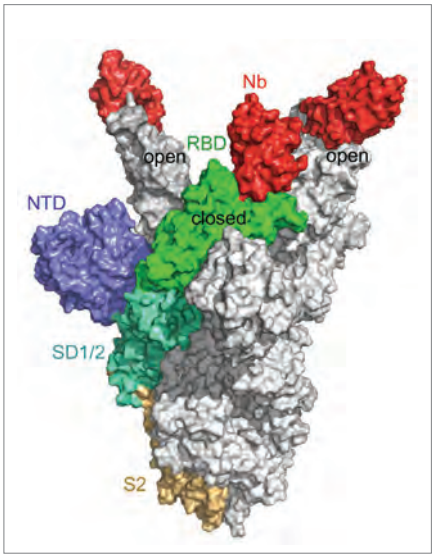


Fig 6: Spike complex with neutralizing nanobodies. The spike trimer is presented in complex with three nanobodies, represented in red. Different structural domains of the spike (RBD, NTD, SD1/2, S2 region) are marked in different colors

	All EMDB entries[1]		SARS-CoV-2 EMDB entries[1]			
	Before Covid19 outbreak[2]	After Covid19 outbreak[2]	Lead continent			Total
			Europe	America/ Australia	Asia	
Total	11,364	6,106	117	413	203	733
Data in EMPIAR	645	342	19	7	0	26
% of data shared through EMPIAR	**5.7**	**5.6**	16.2	1.7	0	**3.6**

[1]Date 2021-11-18 [2]Date 2020-02-10

Table I: Deposition of raw cryoEM data to the EMDB and EMPIAR databases. On the left-hand side, we present the bulk of data deposited in EMDB and EMPIAR before and after Covid19 outbreak. On the right-hand column, we show the number of structures reported in scientific publications in which the leading author worked in different regions of the world.

and initiatives that have been launched in Europe towards data sharing, such as the European Open Science Cloud (EOSC) (https://eosc-portal.eu/).

In a nutshell

In the past few years, cryoEM has quickly evolved from a "niche" discipline in structural biology to being capable of delivering results at the same pace of far more stablished disciplines (and, in many cases, even faster).

The ever-growing capabilities of cryoEM have been highlighted during this pandemic, where the field has indeed significantly contributed many hundreds of SARS-CoV-2-related protein structures, representing an outstanding contribution to our global fight against the Covid19 pandemic. However, we still have lessons to learn. Hopefully before the next pandemic strikes, we will head towards a more open and reproducible scientific environment through a more extended share of raw data. ■

José María Carazo, Biocomputing Unit, Head, Instruct-ES, Director, Spanish National Center for Biotechnology, CNB-CSIC, Madrid, Spain

ACKNOWLEDGEMENTS

The preparation of this short note has involved several people of my laboratory and of the CNB-CSIC that I would like to explicitly mention. They are Marta Martínez, Roberto Melero, José Ramón Macías, José María Casasnovas, Carlos Pérez Mata and Carlos Oscar Serrano-Sánchez. On top of their concrete work for this note, nothing would have been made possible without the sustained effort of the whole Biocomputing Unit of the CNB-CSIC, funded from several National, Regional, European and Industrial grants. Science needs team work, and I am most fortunate to count with an excellent team at the CNB-CSIC. I acknowledge proofreading and many style suggestions of Elena Carazo.

José María Carazo

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Report on EMS extension

Joint meeting of Dreiländertagung multinational congress on microscopy

The Microscopy Conference 2021 (MC2021) was held this year from August 22 to 26. The conference was a joint meeting of "Dreiländertagung" and "15th Multinational Congress on Microscopy" as well as an EMS Extension. The scientific orientation was jointly planned by ten microscopy societies from 11 countries (ASEM/Austria, CMS/Croatia, CSMS/Czech Republic and Slovakia, DGE/Germany, HSM/Hungary, SISM/Italy, SSM/Serbia, SDM/Slovenia, SSOM/Switzerland and TEMD/Turkey). The conference was chaired by Johannes Bernardi, Michael Stöger-Pollach and Stefan Löffler (USTEM/Technical University of Vienna).

At the beginning of 2021 the difficult decision had to be made to hold the MC2021 exclusively as a virtual meeting. Postponing the meeting was not an option. MC2021 was intended to provide opportunities for international scientific exchange especially for "early stage researchers" (ESRs) to develop, network and gain new insights. A large number of younger researchers took the opportunity to present their work with exciting oral and poster presentations.

The program was divided into the three main areas of "Materials Sciences" (8 oral and 5 poster sessions), "Life Sciences" (7 oral and 4 poster sessions) and "Instrumentation and Methods" (8 oral and 4 poster sessions).

In addition, there was a workshop on "The Golgi Apparatus - Microscopy of a complex organelle" organized by Margit Pavelka and Srecko Gajovic and a workshop on "Research infrastructures for Electron Microscopy in Europe" led by Etienne Snoeck, Regina Ciancio and Angus Kirkland. Two special sessions dealt with "EM Core Facility - What is the optimal operational model for serving users?", led by Eija Jokitalo and Aleš Benda, and "Electron irradiation effects in transmission electron microscopy" led by Toma Susi and Arkady Krasheninnikov.

The meeting attracted more than 700 participants from 39 countries. Sponsors and exhibitors were represented by 27 virtual booths and by 16 "Industry Lectures", 12 "Meet the Expert Sessions" and 13 "Meet the Product Sessions", which met with great interest. A zoom solution was used for the electronic poster sessions providing a breakout room for each poster presenter. The preview of the individual posters and access to - or switching between - posters or breakout rooms was rated as very successful by the participants.

The conference was accompanied by 6 excellent and well attended plenary lectures by Marc Willinger (Zürich/CH), Sarah Haigh (Manchester/GB, Holger Stark (Göttingen/DE), Sandra Van Aert (Antwerp/BE), Stefan Raunser (Dortmund/DE) and Andreas Rosenauer (Bremen/DE). The two Ernst Ruska Lectures of the German Electron Microscopy Society were given by David Anthony Muller (Ithaca, NY/US) NS Julia Mahamid (Heidelberg/DE). The highlight of the event, however, was undoubtedly the Harald Rose Distinguished Lecture of the DGE given by Prof. Joachim Mayer (RWTH Aachen and ER-C Jülich). Joachim Mayer gave his lecture in his unsurpassed entertaining way on "Materials science or method development - turn left or right, or go straight ahead?". Despite the early date of this lecture, almost 300 participants listened to Joachim Mayer's presentation.

During the meeting, the DGE General Assembly, the EMS General Assembly, and the MCM Board Meeting were held.

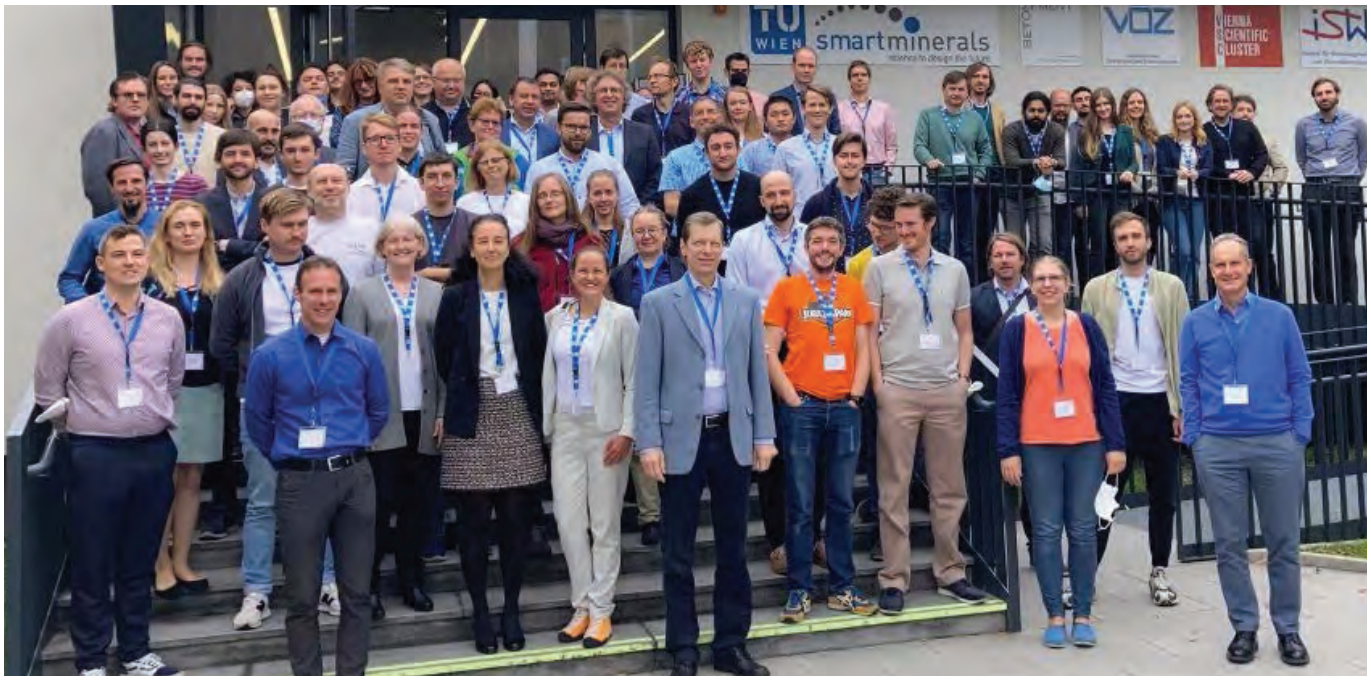
The implementation of the MC2021 as a virtual meeting was due to the extraordinary circumstances. The scientific participants but also the companies saw the necessity for an exchange. Nevertheless, a virtual or a hybrid conference cannot and will not be able to replace a real conference. So the hope remains that we can meet again face-to-face in the near future. ■

Johannes Bernardi (TU Wien, Austria), Conference Chair

Reports on EMS sponsored events

FIT4NANO and EU-F-N workshop, Poland

September 27-29 2021



A joint meeting of the European COST Action FIT4NANO and the European Focused Ion Beam Network was co-organized in Vienna in September 2021. After three successful EuFN Workshops in Graz (2017), in Grenoble (2018) and in Dresden (2019), the joint meeting hosted the 4th EuFN workshop on 27th - 29th of September 2021 and the FIT4NANO Working Groups' meetings on September 30th. The whole event followed a hybrid format, f2f and online.

The main topics of the workshop were oriented towards:

- Simulation and theory (ion solid interaction, materials degradation, gas assisted deposition…)
- Instrumentation (new tools, ion sources, detectors, manipulators, navigation, GIS systems, automation/control)
- Correlative Microscopy
- Micro- and nano-machining
- FIB applications in life science, geoscience and in other new fields
- Local characterization and analytics (SIMS/TOF-SIMS, EBSD, …)
- FIBID and FEBID
- FIB application for failure analysis and circuit edits
- FIB based sample preparation (recipes, best practice) for:
  - TEM
  - XCT
  - APT

The FIT4NANO & EuFN joint meeting attracted more than 150 participants from 28 countries around the world (EU, Australia, Japan and the USA).

One-third of the participants attended the meeting online, via zoom, while the two thirds attended the meeting in person. 55 very interesting talks in total including 6 invited and 7 company talks and 28 posters were presented during the meeting. Frances Allen (University of California in the United States), Jose Maria de Teresa (Instituto de Nanociencia y Materiales de Aragón in Spain), Kimberly Modic (IST Institute of Science and Technology in Austria), Francesc Perez-Murano (Instituto de Microelectrónica de Barcelona -IMB-CNM, CSIC- in Spain), Philip Rack (University of Tennessee in the United States) and Jakob Schwiedrzik (EMPA Thun in Switzerland) were the invited speakers of the FIT4NANO & EuFN joint meeting.

The sponsoring companies/institutions: COST, TESCAN, Raith, Thermo Fisher Scientific, ZEISS, TOFWERK, Kleindiek Nanotechnik, NenoVision, European Microscopy Society and the Technischen Universität Wien supported the joint meeting and allowed the organizers to run the workshop without any conference fee! Moreover, networking events, a conference dinner and a trip to the Institute of Science and Technology Austria (IST Austria) were also organized during the FIT4NANO & EuFN meeting. ■

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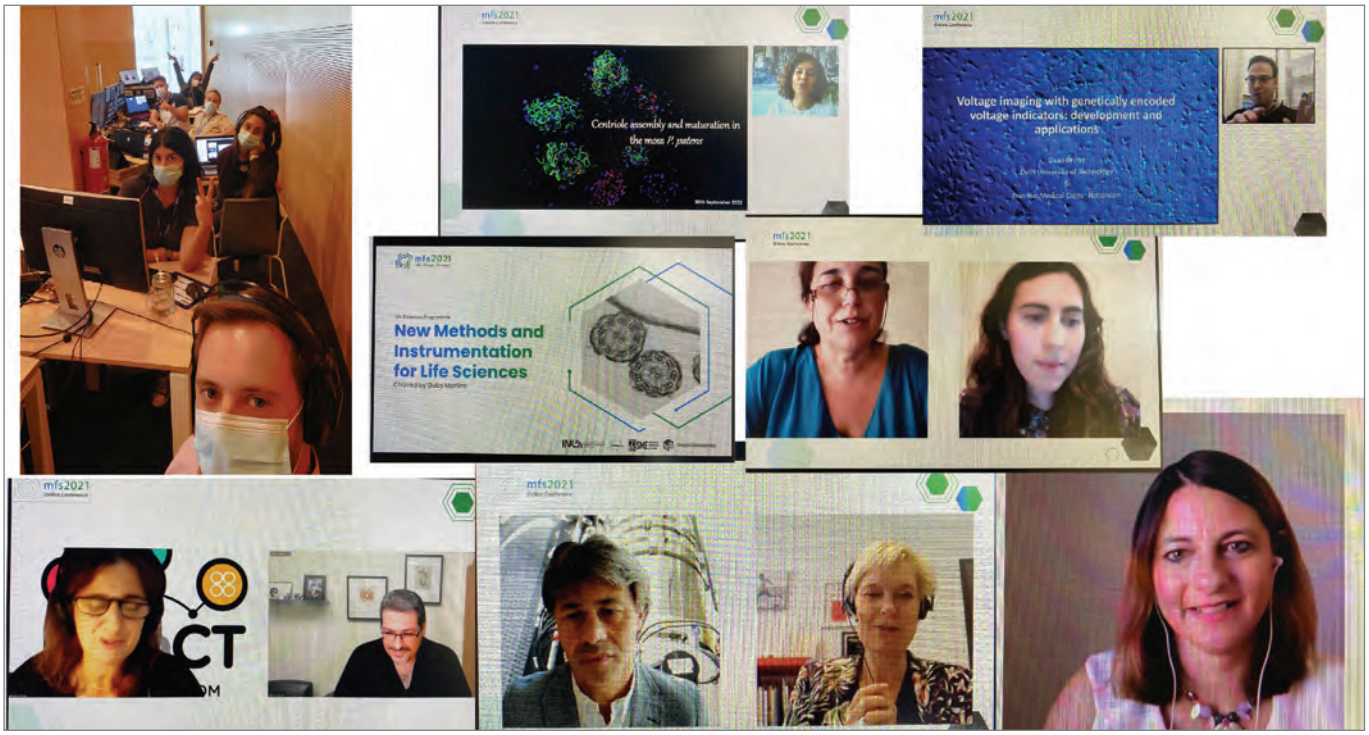
Single molecule localization microscopy symposium, Switzerland

The 10th Single Molecule Localization Microscopy Symposium (SMLMS) was held in Lausanne, from August 31 to September 2, 2021. Its 10th edition continued the successful SMLMS series, including : Zurich 2011, Lausanne 2012, Frankfurt 2013, London 2014 Bordeaux 2015, Lausanne 2016, London 2017, Berlin 2018 and Delft 2019. (meeting history). The scope of the meeting was to bring together scientists from Europe and abroad working in the field of single-molecule super-resolution imaging and other emerging imaging modalities. Thematically, the aim was to look into the future of super-resolution microscopies and how they interface with other methodology microscopy modalities, and novel exciting applications in cell biology.

Distinguished keynote speakers were invited. The Scientific committee included : Suliana Manley, Alexander Fürstenberg and Aleksandra Radenovic. ■

https://smlms.epfl.ch

Microscopy at the Frontiers of Science conference, Portugal-Spain



On September 29th - October 1st 2021, over 200 members of the Spanish and Portuguese Microscopy Societies met virtually at the "Microscopy at the Frontiers of Science" (MFS2021) conference. The event was hosted online by the International Iberian Nanotechnology Laboratory (INL) housed in Braga (Portugal), and jointly organized by both societies (SPMicros and SME).

The event featured three technical tracks in the areas of Life Sciences, Material Sciences and CryoEM and had almost 100 presentations for students to world experts covering a broad array of photonic and electron microscopy techniques.

Participants attending the meeting had the opportunity to interact virtually with superb keynote speakers including Niels de Jonge, Sara Bals, Tamir Gonen and Thomas Müller-Reichert. The conference exhibition hall hosted poster presentations and company demo booths.

Five exceptional students received well deserved recognition for their PhD Thesis work. The recipients of the 2019/2020 Best Thesis awards were:

- SPMicros 2019/2020 Best Thesis Award in Technical Developments
  Recipient: *Catarina Nabais*; Sponsoring company: Thermofisher Scientific
- SPMicros 2019/2020 Best Thesis Award in Life Sciences
  Recipient: *Luisa Ferreira*; Sponsoring company: Izasa Scientific
- SME 2019/2020 Best Thesis Award in Technical Developments
  Recipient: *Mario Peláez Fernández*; Sponsoring company: Thermofisher Scientific
- SME 2019/2020 Best Thesis Award in Life Sciences
  Recipient: *José Luis Vilas Prieto*; Sponsoring company: Izasa Scientific
- SME 2019/2020 Best Thesis Award in Material Sciences
  Recipient: *Javier Pablo Navarro*; Sponsoring company: ZEISS Research Microscopy Solutions

The awards presented at the meeting also included 3 awards for excellent poster presentations earned by *Ítala Silva* (Life sciences Poster Presentation Award), *Jonathan Gabriel Piccirillo* (CryoEM Poster Presentation Award), and *Bruno Oliveira* (Material sciences Poster Presentation Award). The EMS, the Portuguese Microscopy Society and the Spanish Microscopy Society collectively supported 29 Fee Waiver Awards for students.

Thank-you to all the event sponsors who supported our meeting, and congratulations to all the speakers and poster presenters for their excellent contributions. Although it was unfortunate MFS2021 had to be virtual, MFS2023 will again be hosted by the International Iberian Nanotechnology Laboratory in Braga and we are hopeful to see many of our colleagues there in person. ■

Report submitted by Erin Tranfield (President of SPMicros) and Juan de Dios Alché (President of SME)

Phototoxicity in live imaging - The good, the bad and the quantified, United Kingdom

January 19-21 2021 (virtual)

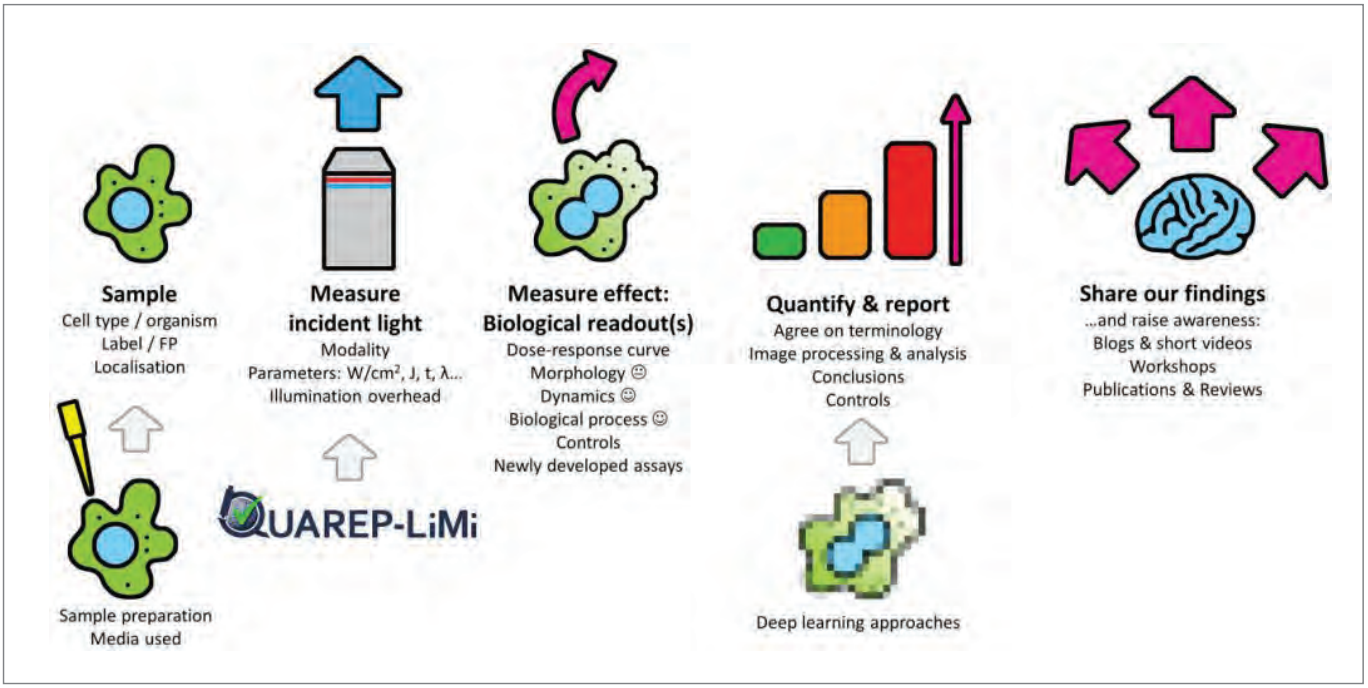
The virtual meeting on phototoxicity was held in late January 2021, generously sponsored by the European Microscopy Society and enabled by the Royal Microscopical Society. In four hours, spread over two days, the five organisers and twenty invited participants discussed the problem of phototoxicity in live imaging, and how we can start to tackle this as a community. This blog article shares the major conclusions we collectively drew from this very insightful, enjoyable and fruitful meeting. Please note that this is a meeting report and not a review – articles on how to assess, minimise and report phototoxicity are referenced here for the interested reader. The discussion was partly based on a Twitter poll series we ran previously.

In the context of live fluorescence microscopy (rather than dermatology), phototoxicity describes the phenomenon by which the light used for fluorescence excitation leads to physiological changes in the observed living sample, be that single cells from a cell culture or a multicellular organism such as a zebrafish. With the excitation light intensities widely used in fluorescence microscopy, these physiological changes are often severe and detrimental and may lead to significant alterations in the biochemistry, physiology and dynamic behaviour of the observed sample. It is also possible that, when observing physiological processes for the first time, more subtle phototoxic effects may go unnoticed as the unperturbed activity is unknown. In either case, the conclusions drawn from these observations could be erroneous and, more dangerously, misleading – since we are not observing a living sample in homeostasis, but documenting the light-induced pathophysiological changes caused by the microscopy method.

We invited 20 participants from a broad range of research fields, some of whom gave short talks on their areas of expertise ranging from instrumentation and deep learning to biological readouts of phototoxicity. The speakers were also asked to share what in their view needed to be addressed most urgently, and if they could already think of solutions to these challenges. ■

https://focalplane.biologists.com/2021/05/14/phototoxicity-the-good-the-bad-and-the-quantified/

Figure1: Graphical Summary of the meeting's main discussion points



Molecular diagnostics, digital pathology and image analysis training school 2021, Austria

February 8 – 12 2021

This year the third *Molecular Diagnostics Training School (MDTS, 8-10 Feb 2021)* and the second *Digital Pathology and Image Analysis Training School (DP&IATS, 11-12 Feb 2021)*, being a joint venture of the Department of Pathology (Medical University of Vienna, Austria) and the Nottingham Molecular Pathology Node (University of Nottingham, United Kingdom), were hosted virtually, as a consequence of the *Global COVID-19 Pandemic*.

Albeit being a great challenge, this global health crisis also acts as a potent catalyst in the shift from the analogue to the digital space, not only in the academic educational setting. Hence, the current events put a new complexion and depth of meaning on one of our main themes of the *training school (TS)*:

'Digital Pathology and Image Analysis: Prepare, the future is here!'

Being aware of the importance of introducing these new and emerging technical methodologies, the *TS* also aimed at providing sound post-graduate education in molecular diagnostics which was encapsulated in the second main theme of the *TS*:

'Applying Molecular Diagnostics is important, not a miracle!'

In line with this statement, lectures on basic methodologies, quality assessment/assurance as well as the implementation of molecular diagnostics that shall be performed on a daily basis, on an organ system level, were given by a number (*n = 41*) of world-renowned experts in these fields.

Top left-hand corner: The Chair of the MDTS & DP&IATS 2021, the following images constitute a subset of the speakers who gave consent to use their photographs for this report.

KLINISCHES INSTITUT FÜR PATHOLOGIE

MEDIZINISCHE UNIVERSITÄT WIEN

Wiener Gesundheitsverbund
Universitätsklinikum AKH Wien

After a week of intense lectures (~8.30 am – 6 pm) and lively discussions with a daily average attendance of 50 attendees (range: 38 – 60) we were delighted by the feedback from attendees (two representative feedback statements were as follows):

"Excellent training course, congratulations!!!! Many sincere thanks for this knowledge sharing!!!" (MDTS)

"Online courses were a good introduction into what will be the future of pathology, perfectly organized, thanks for that!" (DP&IATS)

Hosting these TS on our dedicated event platform (Whova) also added to the success of this online event, which is reflected by the feedback and the consistent and animated engagement of attendees, and we are looking forward to the upcoming *MDTS & DP&IATS 2022*. We therefore want to extend our special thanks to the European Microscopy Society for sponsoring our *TS*! ■

Renate Kain[1], Mohammad Ilyas, Leonhard Müllauer[1], chairs

Organising Committee:
Mag. Gertrude Krainz[1]
Maximilian Köller[1],

1) Medical University of Vienna, Department of Pathology, Austria

2) University of Nottingham, Division of Cancer and Stem Cells, United Kingdom

Reports on special events

SEEM 2021, 2nd Sino-European early career researchers workshop

7-10 December 2021

Following the success of the 1st Sino-European Early Career Researchers Workshop on Emerging Techniques and Applications in Electron Microscopy in December 2020, the second event of this series took place on 7-10, December 2021, again concluded a great success. The workshop is sponsor-free, non-for-profit and free to attend, organized by four Europe-based young microscopists, Dr. Pei Liu (Technical University of Denmark, DK), Penghan Lu (Research Center Juelich, DE), Dr. Mingjian Wu (University of Erlangen-Nuremberg, DE) and Dr. Zezhong Zhang (University of Antwerp, BE). This annual workshop aims to set up a regular bilateral forum for electron microscopists based in China and Europe, especially early career researchers and young PIs.

This year the workshop focuses on four scientific sessions, including:

1. learning from and contributing to cryo-EM,
2. automation, data handling and deep learning,
3. advancing *in situ* electron microscopy and
4. quantification in multi-dimensions with four keynote lectures given by senior professors, 20 invited talks given by early career researchers and young PIs from 7 European countries and China.

At the end of each session, a panel discussion led by the keynote lecturer turned out to be stimulating and insightful. Beyond the scientific sessions, two forums namely techno-bite and career development were also organized and received high recognition. In the techno-bite forum, industrial guests presented their technical innovations and perspectives of democratization of electron microscopy products. In the career forum, guests at different stages of their career, ranging from postdocs to faculty dean, shared their views of developing career pathways in academia.

The workshop has attracted 430 registrants from 27 countries and more than 120 organizations. Almost 300 colleagues have eventually participated in the workshop and contributed about 200 questions in the Q&A sessions after the talks, as well as many more comments during the panel discussions. Thanks to the online platform, excessive questions could be answered offline and shared with all participants. During and after the workshop, the organizers received positive feedback from the attendees about the outstanding quality of the invited talks, the deep insight from the panel discussions, as well as the smooth organization and the welcoming atmosphere. We are looking forward to meeting more colleagues next December 6-9 in SEEM 2022! ■

Pei Liu, Penghan Lu, Mingjian Wu and Zezhong Zhang

BIST symposium on microscopy, nanoscopy and imaging sciences. Barcelona, Spain

The 4th edition of the BIST Symposium on Microscopy, Nanoscopy and Imaging Sciences was successfully organized in June 2021.

A great list of keynote speakers, including electron microscopy, optical microscopy, scanning probe microscopy, Raman Imaging and Spectroscopy, Imaging Technology and correlative microscopies, among others, participated and made for a wonderful event once again.

The event was one of the activities that the Spanish Microscopy Society (SME) sponsored in 2021.

The conference had more than 200 attendees, 8 keynote speakers and 24 flash talks. The list of Keynote speakers included: Niels de Jonge (INM – Leibniz Institute for New Materials; Saarbrücken, DE), Guillaume Schull (Institut de Physique et Chimie des Matériaux, Strasbourg, FR, Frances M Ross (MIT, MA, US), Roger Proksch (Asylum Research and Oxford Instruments, Santa Barbara, US), Verena Ruprecht (CRG, Barcelona, Spain), Willy Supatto (Ecole Polytechnique, Paris, FR), Francisco Balzarotti (Research Institute of Molecular Pathology, Vienna, AU), and Melike Lakadamyali (University of Pennsylvania, US). ■

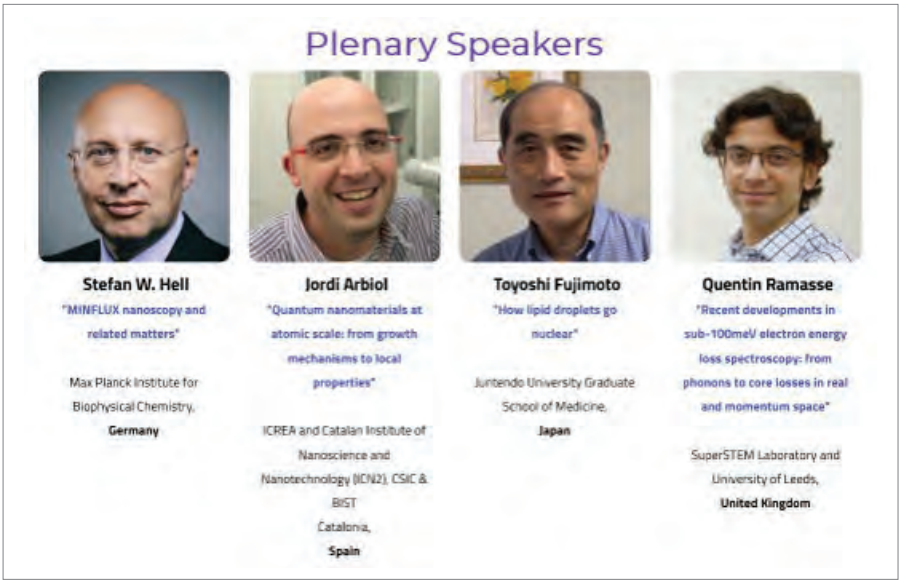
https://bist.eu/events/event/2021-bist- symposium-on-microscopy-nanoscopy-and-imaging-sciences/

Double virtual congresses of Turkish Society for Electron Microscopy for its 50th birthday

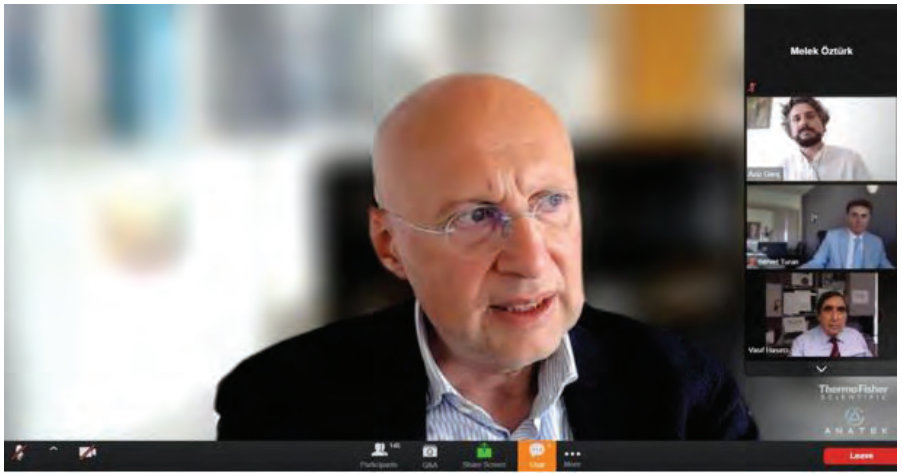
25th National Electron Microscopy Congress (EMK2021) and 1st International Microscopy and Spectroscopy Congress (MSC2021) have been organized as virtual congresses on September 22-24, 2021, under the auspices of the Turkish Society for Electron Microscopy (TEMD) by İzmir Institute of Technology.

This year marks the 50th anniversary of the TEMD, and our national microscopy congress was held online for the first time due to the pandemic worldwide. Assoc. Prof. Aziz Genç (Izmir Institute of Technology) was the chair, and Prof. Servet Turan (Eskişehir Technical University) was the co-chair of the congresses. This three-day virtual event enabled participants to hear from worldwide on the wide variety of microscopy-related research and technical developments in the fields of life sciences and materials sciences.

Prof. Stefan W. Hell's opening plenary speech, which won the 2014 Nobel Prize in Chemistry, was about the MINFLUX nanoscopy and related matters. Three more plenary sessions comprise keynote lectures given by Prof. Toyoshi Fujimoto (Japan), Prof. Quentin Ramasse (UK), and Prof. Jordi Arbiol (Catalonia, Spain). The subjects of the congresses were divided into 29 sessions between life sciences, materials sciences, and instrumentation.



Forty-three internationally renowned scientists had been invited to present state-of-the-art research they have been working on. The scientific program also included 53 contributed oral presentations and 20 poster presentations, which our Scientific Committee reviewed. A total of 312 participants were registered to the online conference system. A Book of abstracts can be found on the conference website www.msc2021.com. ■



EMAG meeting at RMS-MMC21

Online 4-6 July 2021

The electron microscopy and analysis group (EMAG) is a special interest group of the UK Institute of Physics. We focus on the development and use of electron beams for microscopy, lithography, structural and chemical analysis within the physics community and beyond (EMAG website).

EMAG holds a biennial UK meeting covering all aspects of physical science microscopy applications, including instrumental or technique development. As has been the case in recent years, the 2021 EMAG meeting was incorporated into the Royal Microscopical Society's (RMS) *mmc*2021 meeting, which took place virtually for the first time! *mmc*2021 was an international scientific virtual conference of six parallel streams, covering an enormous range of microscopy, cytometry and imaging topics with more than 1,300 participants logged on from across the world.

Notably, *mmc*2021 required the creation of a bespoke conference website, which broke new ground for the RMS and we were extremely grateful for all their efforts in developing this. The website featured an integrated abstract admissions system, the embedding of both Vimeo and Zoom for the live conference streams and included an online commercial exhibition with a range of interactive options for delegates and visitors. The EMAG scientific programme consisted of 10 separate conference sessions with invited speakers, posters and a plenary session covering 'Adventures in 4D-STEM' by Prof J. Etheridge of the University of Monash (Australia). The programme was arranged by the EMAG committee to reflect the breadth and quality of the submissions of ~ 130 delegates and to ensure it is representative of the current community's activities. A copy of the programme and abstracts submitted is available here:

https://www.mmc-series.org.uk/general-information/previous-congresses.html.

As ever, the range of science presented was truly excellent and an added advantage of the online format was significant growth in contributions and participation from international delegates. While the natural buzz and footfall of an in-person event can never truly be replicated, this was the best possible alternative; it was an exciting meeting with good attendance and engagement at the online scientific sessions. A reflection on EMAG2021 by Natalia Koniuch, a PhD student at the University of Leeds is given below.

*'Over the last year or so we've managed to get used to remote working due to the COVID-19 pandemic, therefore the decision to deliver mmc2021 incorporating EMAG virtually came as no surprise. As a third year PhD student in the electron microscopy field, EMAG is an invaluable conference for my progression, offering the opportunity to interact with experts in the field and learn more about current research and development. EMAG offered an inspiring Plenary about 4D-STEM (by Prof Etheridge) and a series of impressive invited talks and interesting contributed and flash talks, divided into several, themed streams. I had the fantastic opportunity to present my research entitled '**Using transmission electron microscopy to monitor hydration of theophylline**' in a supportive environment and get constructive feedback from experts in my field. I found EMAG2021 to be a very informative and engaging event, especially for newer and younger researchers, and even with the online format I felt it was full of interesting discussions that may lead to collaboration in the future and definitely helped my identify emerging areas of research interest such as the wider application of STEM techniques.'*

Going forwards, planning is underway for *mmc*2023 incorporating EMAG2023 with the intention of returning to an in-person meeting in Manchester, July 2023 and hopefully retaining some positive aspects of the virtual format – we very much look forward to seeing some of you there. ■

Dr Andy Brown and Prof Jun Yuan, outgoing and incoming EMAG chairs respectively.

NORDTEMHUB @SCANDEM
A new Nordic hub on advanced TEM in the physical sciences

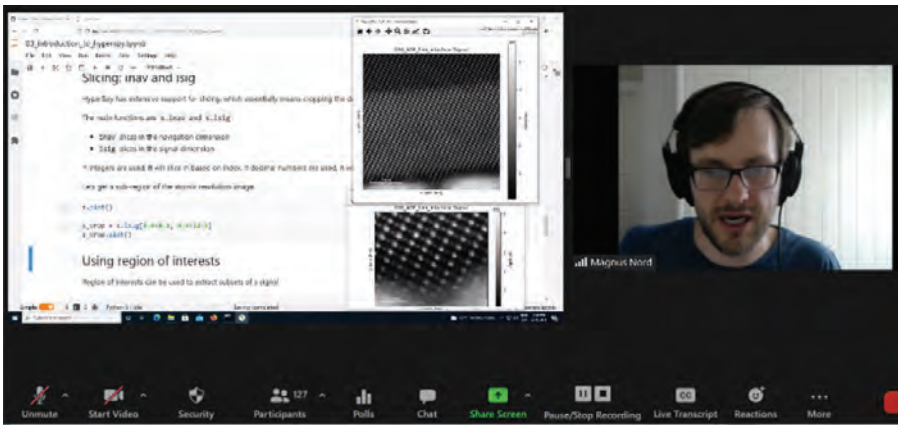
The Nordic network in transmission electron microscopy (TEM) and materials science – **NordTEMhub** – was granted in 2020. This is a network funded by NordForsk, gathering the TEM groups in physical sciences from seven universities in the Nordic countries: Linköping University (LiU), Stockholm University, Chalmers, Denmark Technical University (DTU), Aalto University, University in Oslo (UiO) and Norwegian University of Science and Technology (NTNU) – for utilizing complementary instruments, cooperating and working together, running workshops, having student exchange, finding best practice in lab management etc.

The aim is to establish collaborations, provide access, optimize instrument use and build and utilize Nordic competence on advanced microscopy. Common to all the nodes are recent and significant investments in state-of-the-art transmission electron microscopes. This initiative adds value to academia and industry in the Nordic countries and strengthens the Nordic competence in electron microscopy within materials, physics, chemistry and adjacent disciplines.

Because of Covid, the start of the Hub has been very delayed, but we organised an online kick-off meeting with 75 participants Friday 18th June 2021. Here we had presentations of the labs and group work across nodes to get to know each other, plan and discuss how we can collaborate.

21.-23. June 2021 NTNU in Trondheim organised the first NordTEMHub workshop on '**Open source analysis of TEM data**' and 200 participants attended online. We had lectures and practicals given by Katherine MacArthur (Jülich, Germany) Colin Ophus (Berkeley Lab, USA) Philip Crout (Cambridge, UK) and Magnus Nord (NTNU, Trondheim, Norway). Participants had to install the software (Hyperspy and py4DSTEM) and did analysis themselves on their own computers during the practicals. The workshop was very well received, and the participants said they had learned a lot. In 2022 there will be more workshops, organised by UiO and DTU. ■

Text written by prof. Randi Holmestad, NTNU and prof. Per Persson (NordTEMHub project leader), LiU.



Magnus Nord, NTNU, teaching how to use Hyperspy.

LEICA and Imperial College: a new imaging hub @White City and South Kensington Campuses

Imperial College London and Leica Microsystems launched a dedicated biomedical imaging hub focusing on complex dynamics in biological systems beginning of 2021. The Leica and Imperial College Imaging Hub is based at Imperial College London's White City and South Kensington Campuses. The purpose of the Hub is to establish a strategic collaboration in the field of optical imaging and its uses in research and innovation.

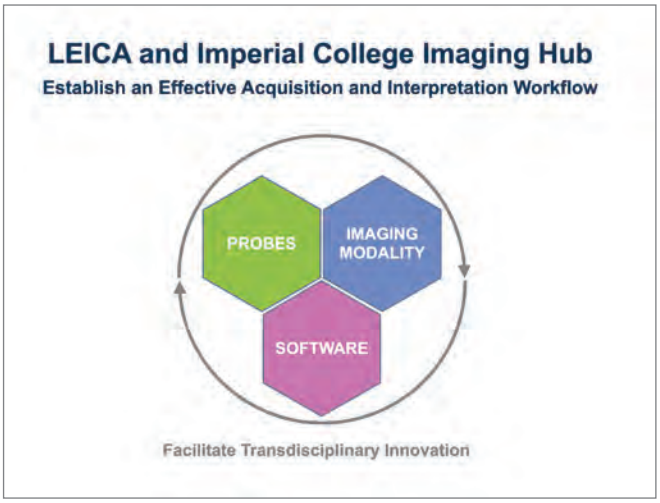
Leica Microsystems and Imperial College London will cooperate to research, develop and promote scientific applications using Leica's latest technologies. The Hub is equipped with cutting-edge confocal and wide-field microscopy systems. Demonstrations of new systems are envisioned and workshops such as the 'See the Hidden' series of Leica will bring together expertise from across the scientific community (recent announcement: **https://microscopyfocus.com/see-the-hidden-cancer-research/)**.

The Hub will also serve as a platform for Imperial College London and Leica Microsystems to maintain a close dialogue on the value of microscopy in development and research applications, as well as to collaborate on joint research projects. A Council of Operations, which is chaired by Dr Periklis (Laki) Pantazis, Reader in Advanced Optical Precision Imaging at the Department of Bioengineering at Imperial College London, will facilitate this industry–university collaboration. It will focus on understanding biological systems to advance human health by exploring i) probes, molecular agents to visualise, quantify and manipulate cells or organism, ii) imaging modalities, equipment and methodologies used to acquire images from the molecular to the tissue level of the human body and iii) software that process the data produced.

The interplay between these factors is what allows researchers to obtain an accurate visual display of complex dynamics in biological systems. The Hub will combine these factors in one place, generating a unique environment that will establish an effective acquisition and interpretation workflow and facilitate innovation and development across disciplines and communities of experts.

One of the long-term aims is for researchers at the Hub to use optical precision imaging in monitoring and predicting response to medical treatments. In addition to the potential medical advantages of the Hub, its technology and collaborations will benefit both the industry and the academic community alike by technology transfer and training. ■

Periklis Pantazis



Ernst Ruska Prize 2021

Dr. Julia Mahamid and Prof. David A. Muller awarded

The Ernst Ruska Prize is awarded by the German Society for Electron Microscopy (DGE) every two years for outstanding achievements in the field of electron microscopy. The prize is given for work carried out by preferably younger scientists pioneering new capabilities of electron microscopy through innovative instrumentation or novel methods of basic and general interest. The decision is made by the independent Ernst-Ruska-Prize committee, which is elected by the DGE members.

2021 Ernst-Ruska-Prize awardee
Dr. Julia Mahamid

The Ernst Ruska Prize 2021 was awarded at the online Microscopy Conference (Dreiländertagung and Multinational Congress) MC2021 during the plenary session that was assigned to the Ernst-Ruska-Prize award ceremony and plenary talks of the awardees. The award was presented by the President of the DGE, Prof. Dagmar Gerthsen, to two outstanding scientists. Dr. Julia Mahamid from the European Molecular Biology Laboratory (EMBL) in Heidelberg receives the prize for her outstanding work that has led to the substantial "Advancement of the Boundaries of Cellular Electron Tomography". The second awardee, Prof. David A. Muller from Cornell University (Ithaca, USA), receives the Ernst Ruska Prize for his pioneering work on "Ultra-high Resolution Electron Microscopy and Spectroscopy".

Dr. Julia Mahamid studied biology at the Technion, the Israel Institute of Technology (Haifa, Israel), and at the Weizmann Institute of Science (Rehovot, Israel). She graduated in 2010 at the Weizmann Institute of Technology with a thesis entitled "Structural Investigation of Bone Mineralization Processes in the Zebrafish Fin and Embryonic Mouse Models." As a postdoctoral fellow in the lab of Prof. Wolfgang Baumeister at the Max Planck Institute for Biochemistry (Martinsried, Germany) she studied centrosomes and RNA granules in situ. Since 2017, Julia is a group leader in the Structural and Computational Biology Unit at the European Molecular Biology Laboratory (EMBL in Heidelberg, Germany) where she is analyzing membrane-less cellular compartments using in-cell structural biology techniques.

Julia has received several awards and fellowships. In 2020 she was awarded the Bayer Foundation Early Excellence in Science Award, and in 2017 she received a prestigious European Research Council Starting Grant. She is an elected member of the Elisabeth-Schiemann-Kolleg of the Max-Planck-Society.

In order to advance our understanding of the molecular architecture of the cell, Julia has pioneered the use of cryo-focussed-ion-beam scanning electron microscopy (cryo FIB-SEM) for sample preparation to perform cryo-electron tomography. She has optimized the method to produce lamella for cryo-electron tomography by the wedge pre-milling technique and surface coating procedures – work that has been published in the Journal of Structural Biology and has been awarded as Paper of the Year 2017 by the journal. Using this technique, it is possible to produce a more uniform thickness of the lamella compared to the simple rectangular pattern milling. The wedge pre-milling technique allows to adjust the thickness of the lamella to meet the requirements of the sample in terms of internal crowding and resolution to be achieved as well as specific acquisition needs.

Furthermore, Julia advanced correlative light microscopy – electron microscopy approaches to guide the FIB milling process to the features of interest that might be low-abundant or dynamic subcellular structures within the large landscape of a cell. She was also involved in establishing the use of the Volta phase plate for data acquisition by cryo-electron tomography on lamella to increase contrast and facilitate recognition of features of interest.

"It is fantastic to see what can be achieved by combining methods and techniques to provide three-dimensional information of the cell."

Screenshot showing the Ernst-Ruska-prize awardee Dr. Julia Mahamid (bottom right), the Ernst-Ruska-prize certificate, and Prof. Dagmar Gerthsen during the online award session.

Combining these developments Julia Mahamid and her colleagues characterized the molecular organization of a HeLa cell nuclear periphery by cryo-electron tomography. This excellent work has been published in Science and has been awarded by the European Microscopy Society with the Outstanding Paper Award in the area of Life Sciences in 2016. The workflow is not limited to a specific organism or cell type but can be applied and adjusted to a sample of interest.

In recent years, Julia is focusing on the characterization of cellular, cytoplasmic compartments that are not surrounded by membranes but rather assemble dynamically by phase separation using the techniques she and her colleagues developed.

It is fantastic to see how Julia brings together molecular and cellular structural biology and what can be achieved by combining methods and techniques to provide three-dimensional information of the cell.

Prof. David A. Muller studied physics at the University of Sydney and then went to the USA to obtain his Ph.D. at Cornell University in 1996. Thereafter he was a member of the technical staff at Bell Laboratories from 1997 to 2003. Returning to Cornell University, he became a professor there. Today he is the Samuel B. Eckert Professor of Engineering and Co-director of the Kavli Institute (since 2010). David Muller has received already many awards among them the Peter Duncumb Award for outstanding achievements in the field of microanalysis (Microbeam Analysis Society, 2016) and the Burton Medal of the Microscopy Society of America (2006). He also is a Fellow of the Microscopy Society of America (March 2013) and a Fellow of the American Physical Society (March 2012).

David Muller has been regarded for many years as a pioneer of quantitative atomic-scale electron-energy loss spectroscopy in scanning transmission electron microscopy. He applied these techniques to a large variety of materials such as oxides and 2D materials. He also has been focusing on materials for batteries and fuel cells. The combination of application-relevant method development and study of materials is certainly the basis of David Muller's outstanding work.

However, the Ernst Ruska Prize honors in particular work related to ultra-high-resolution imaging performed in the past few years. It started when

2021 Ernst-Ruska-Prize awardee
Prof. David A. Muller

Screenshots showing the Ernst-Ruska-Prize awardee Prof. David Muller (bottom right), the Ernst-Ruska-prize certificate, and Prof. Dagmar Gerthsen during the online award session.

David Muller engaged in the development of a pixel-array detector for electron microscopy together with his colleague Sol M. Gruner. In his construction, he aimed at high-sensitivity, high-dynamics, and high-speed detection of electrons in diffraction patterns. The successfully developed EMPAD detector (electron microscope pixel array detector) was published in 2016 and is nowadays implemented in many commercial transmission electron microscopes. This detector was used by David and his group in numerous applications. The availability of the pixel-array detector was also the prerequisite for the progress that was made in the application of ptychography, i.e. lens-less imaging.

" This work can be considered as the breakthrough of ptychography in electron microscopy, nearly 50 years after this technique was first described."

In their 2018 Nature publication, David and his colleagues used the self-built EMPAD detector to dramatically push the resolution limit of ptychography. He achieved a resolution of 39 pm at an electron energy of 80 keV, which is the best resolution ever achieved in an electron microscope. It was also four times better than the best resolution achieved to date at 80 keV. This work can be also considered as the breakthrough of ptychography in electron microscopy, nearly 50 years after this technique was first described by Hergerl and Hoppe. The work published in 2018 required very thin samples. In one of his most recent publications, David Muller presents an approach that does not require two-dimensional samples anymore that may be promising to extend the application of ptychography.

Due to the online format of the conference, it was unfortunately not possible to hand over the award certificates in person, but screenshots were taken during the online award ceremony (below) that show the awardees and the award certificates. As a note at the side, the time of the award session for David Muller was 6 hours back, i.e. 2 am in the night. This was commented by him that his usual work hours often last until 3 am and the local time would be not at all a problem for him.

The virtual presentation of the award certificates was followed by the Ernst-Ruska-Prize lecture given by David Muller. In his fascinating plenary talk with the topic "Making every Electron count - New Science enabled by Pixel-Array Detectors" he presented insights into the development and properties of pixel-array detectors. He also introduced his most recent work and outlined the perspectives of ptychography. The technique is particularly promising for organic, weakly scattering material. It will be exciting to see what can be achieved with ptychography in the future.

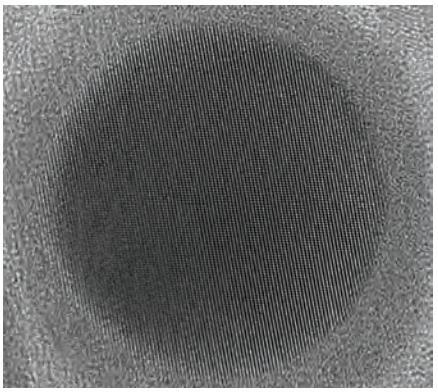
The chair of the award session was then taken over by PD Dr. Katharina Hipp, the representative for life-science electron microscopy on the DGE board. She gave the Laudatio for Dr. Julia Mahamid and introduced Julia Mahamid s award lecture on "Molecular Views into Cellular Functions by In-Cell Cryo-Electron Tomography". In her excellent talk Julia Mahamid outlined the achievements of the technique over the last years enabling structural studies *in situ*. She also presented an integrative structural biology approach to address compositional and structural heterogeneity in the cell. By integrating different cryo-EM methods Julia Mahamid showed results that revealed binding of a small compound to a complex inside the cell pointing to future directions of structural biology. ■

Dagmar Gerthsen und Katharina Hipp

People's Choice Award of the RMS picture competition 2021

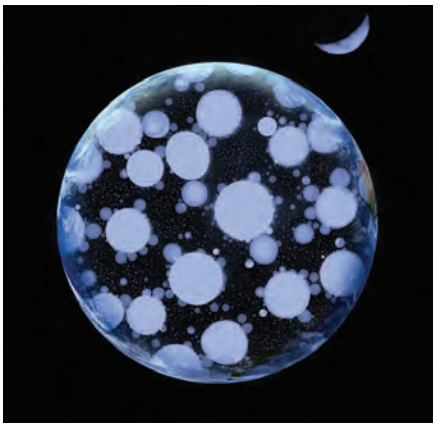
Nitin Arya is currently pursuing his doctoral degree on 'Synthesis of Silicon Nanowires for electronics applications' with Prof. Dusane's group in Thin Films and Plasma Processing laboratory at the department of Metallurgical Engineering and Materials Science, Indian Institute of Technology Bombay, India.

Two of his Transmission Electron Micrographs were awarded the 'People's Choice Award' in International Scientific Imaging competitions of Royal Microscopical Society (150+ submissions from 40 countries and organised as a part of Microscience Microscopy Congress 2021) and NanoArtography (195 submissions from 28 countries) held in July and September 2021 respectively. The contests combine nanoscience and art and the award is given to people who can creatively transform microscopic images into an eye-catching piece of art without compromising much to the original features of the image.

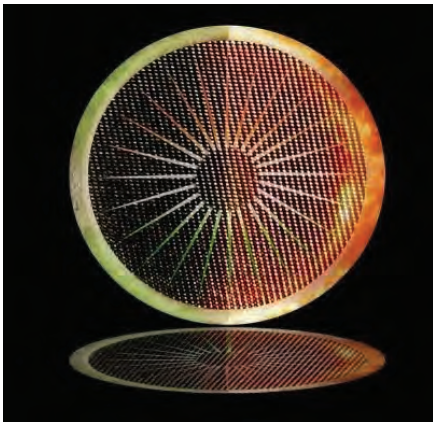


Nitin has a special interest in microstructural characterization and analysis of materials through techniques such as Atom Probe Tomography and STEM. The award-winning images and links to them are as follows:

- **https://www.rms.org.uk/study-read/news-listing-page/imaging-competition-2021-winners-announced.html**
- **https://www.nanoartography.org/2021**

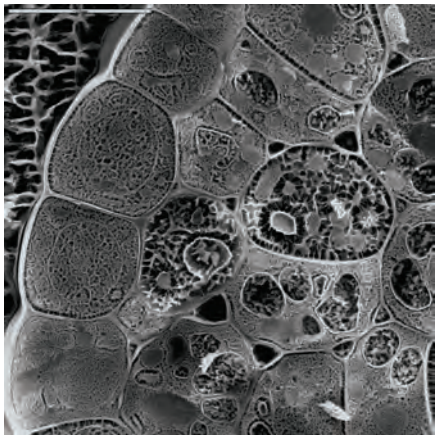


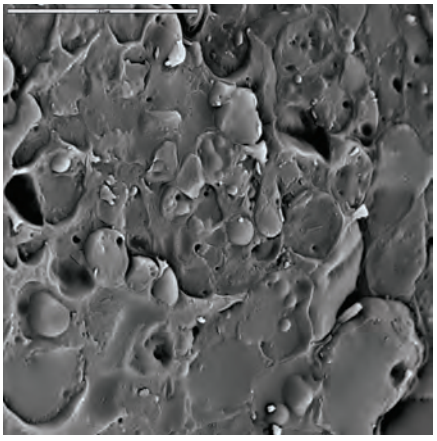
People's Choice Award - Royal Microscopical Society



People's Choice Award - NanoArtography

CRYO-SEM, picture competition awarded during the Society for Low Temperature Biology Meeting





Last November, we presented this SEM micrograph to a cryobiology-related photography competition, within the *Society for Low Temperature Biology Meeting (SLTB 2021)*, and the organizing committee was kind enough to award it the first prize.

Cryo-SEM can be very useful to get a quick comparative map of concentration/viscosity/molecular mobility of the different cellular and tissue compartments (cytoplasm, vacuole...): more concentrated solutions (more viscous/with a smaller molecular mobility) develop smaller ice crystals.

The picture had been obtained studying ice crystals avoidance in cryopreservation. Mint axes were submitted to dehydration procedures to reduce the probability of ice formation when quench-cooled in liquid nitrogen. As this process progressed, cryo-SEM images were growing in detail/resolution. Actually, the image is formed by "dark spots" corresponding to ice crystals voids, after gold covering. Voids form in the "etching" process: sample temperature (after entering the microscope in liquid nitrogen) is risen to -90° C under vacuum, for a few minutes, so that ice crystals sublimate partially, leaving "voids". Increasingly dehydrated tissues show more but smaller ice crystals (improving "resolution"). However, we found that when samples got vitrified (as checked by DSC), images appeared "snow-covered", losing all resolution. This is due to the null or much reduced degree of sublimation of glassy water. In this way, we had a procedure for visualizing individual glassy cells.

Fernando Pinto, the microscopy technician of the *Centro de Ciencias Medioambientales* (CSIC) that helped us to obtain these pictures, sadly died soon after finishing this work. The cryo-SEM microscope "died" with him: they could not set it to work again. This microcopy service was discontinued. ■

Antonio D. Molina-García (ICTAN-CSIC, Madrid, Spain, antoniom@ictan.csic.es) and Aline Schneider-Teixeira (CIDCA-CONICET-UN La Plata, Argentina)

New RMS data analysis in imaging section

There is an ever growing demand for image analysis in microscopy. Alongside this comes the need for a trained and better-organised community of image analysts who will support this growth. We are happy to announce that the Royal Microscopical Society (RMS) have come together with the UK community to form a new scientific section of the RMS - Data Analysis in IMaging (DAIM, pronunciation /daim/; **https://www.rms.org.uk/network-collaborate/science-sections/image-analysis.html**).

DAIM started life as an RMS Focused Interest Group (IAFIG) that was started in 2018 and whose role was to develop and support the image analysis community in the UK in parallel and complementary to wider activity such as NEUBIAS (Network of European Bioimage Analysts, est. 2016).

During this IAFIG's lifetime, Dr Dominic Waithe **(https://www.rdm.ox.ac.uk/people/dominic-waithe)** acted as chair and the IAFIG organised a variety of community meetings and training events. Of particular note were the "Train-the-trainer" course for image analysis trainers; the week-long "Python for Bioimage Analysis" course (pictured) and several reports on the research climate for bioimage analysts in the UK (e.g. **https://doi.org/10.12688/f1000research.51794.1**).

The IAFIG demonstrated the need for explicit representation of image and data analysis in microscopy, both for improving research and reproducibility but ensuring advocacy of a strong career route for image analysts.

And so, working with the RMS and the image analysis community, Dr Martin Jones and Dr Chas Nelson have transitioned the IAFIG into a new, full scientific section at the RMS - the Data Analysis in IMaging (DAIM) section. Our thanks go to the whole RMS and IAFIG teams including, but not limited to, Professor Maddy Parsons, Allison Winton and Amanda Jarman for all their guidance and support.

DAIM aims to build on the excellent foundations provided by the IAFIG to support the image analysis community in the UK; however, DAIM's focus is slightly broader and we hope to support both life and physical sciences areas, in collaboration with other RMS sections, including horizon scanning and working with other communities where data analysis is at an early stage.

Over the coming months we hope to see new community-led standards and journal special issues, a new image analysis training schedule and more. All of which will be directed by and led by the community.

As data analysis in imaging is such a broad area we're aiming to ensure representation of a range of fields, modalities and career stages by forming short-term working groups that can communicate across RMS sections, other organisations and beyond. So, if you see a data analysis need in your field please reach out to any of the committee, whom you can find listed here: **https://www.rms.org.uk/network-collaborate/science-sections/image-analysis.html.**

Image: **https://twitter.com/dwaithe/status/1217201489770352645/photo/1**

Chas Nelson

Prof. Brian J. Ford, Honorary Fellow of the RMS, made fellow Honoris Causa of the Linnean Society of London

Brian J Ford, who was recently elected Honorary Fellow of the Royal Microscopical Society, has just been made a Fellow *honoris causa* of the Linnean Society of London.

The Royal Microscopical Society is the oldest microscopical organisation in the world, and they reported that Ford has made "a significant contribution to microscopy and biology and to the popularisation of these fields. Professor Ford, who is resident in Cambridgeshire, is known internationally for his thought-provoking lectures, books and broadcasts." The RMS mentioned his earlier books, including *The Revealing Lens, Mankind and the Microscope*, and T*he Optical Microscope Manual*, both published in 1973. They add: "In the 1980s Professor Ford unearthed the original microscopical specimens sent by Leeuwenhoek to the Royal Society in the seventeenth century, resulting in his book *The Leeuwenhoek Legacy*. In the 1990s Professor Ford compiled the first digital microscope manual for a scheme that gave a microscope to every state school in England and Wales. In 2006 he was appointed Visiting Professor at Leicester University."

The Linnean Society of London, in appointing him Fellow *honoris causa*, said Prof. Ford is: "a strong advocate of interdisciplinary research, and has published extensively on microscopy, embracing fields such as food science, microbiology, forensic analysis and blood coagulation.

He has been a Fellow of the Linnean Society for over 50 years and served on Council for many years, including as Zoological Secretary. Brian is also our Honorary Surveyor of Scientific Instruments." Like the RMS, the Linnean Society, the earliest life-sciences society, has a limit (25) on the number of honorary fellows they can appoint. ■

Q-Sort EU-funded project @Horizon 2020 Future and Emerging Technologies

The Q-SORT project has successfully created a new generation of electron microscopes - so-called 'Quantum Sorters' - that are able to extract previously unavailable information about samples by changing the very concept of measurement.

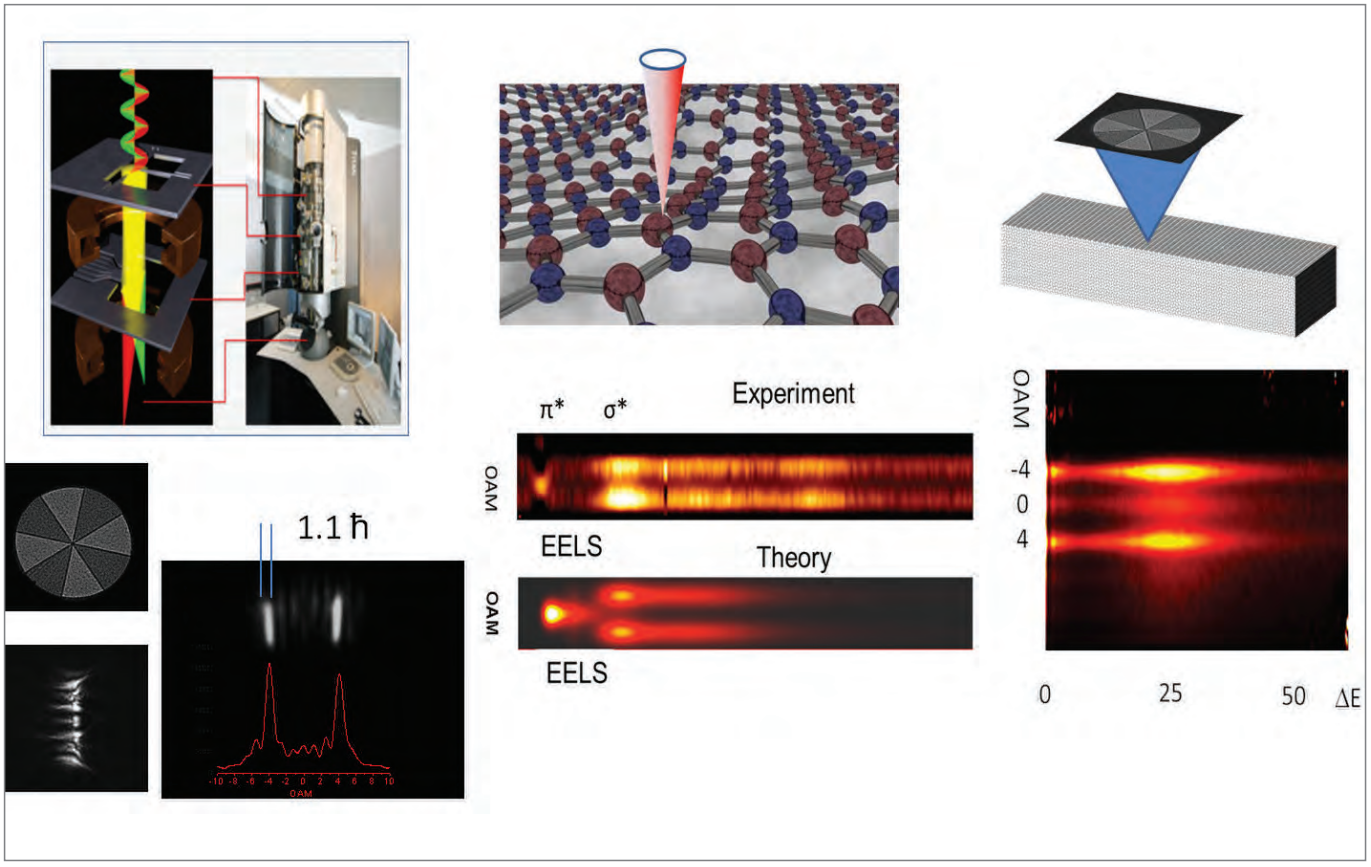
For decades, both scientists and the wider public have marveled at images produced by electron microscopes. Modern instruments can fire powerful electron beams to form images that have atomic spatial resolution. However, electron microscopes are much more than just imaging tools: they can also be used to study properties such as atomic composition, as well as magnetic, mechanical, structural, and electronic properties of materials.

According to quantum mechanics, the information that can be measured about a single electron is limited and depends on the measurement process. By developing and using a "Quantum Sorter", we have shown that it is possible to retrieve crucial information that is usually hidden - for example about the symmetry of a scattering object, which is of interest in studies of atomic orbitals, where a specific rotational symmetry provides information about chemical bonds, magnetic states or electronic states.

An important issue in electron microscopy is damage to (or even destruction of) delicate samples, such as proteins, by an incident electron beam. This 'dose problem' results in the need to find a trade-off between spatial resolution and sample integrity. In this context, it is significant that a "Quantum Sorter" allows a specific quantity of interest about a sample to be measured optimally.

A "Quantum Sorter" transforms the quantum state of an electron that has probed a sample, thereby maximising the information that can be extracted per incident electron and allowing the measurement of properties of the sample that are not normally accessible.

This is a game-changing development in electron microscopy. Q-SORT assessed the benefits of using a "Quantum Sorter" for probing delicate specimens with extremely low damage, for characterising quantum states of plasmonic excitations and for



measuring selection rules in atomic transitions excited by beam-sample interactions.

Q-SORT resulted in the development of new devices, in which MEMS technology was used to control and shape the electron wavefunction, as well as to 'sort' its quantum states. It required the building of an orbital angular momentum Sorter and demonstrations of its use to provide unprecedented results on the characterisation of atomic transitions, plasmon excitations and protein symmetries.

Applications of the Quantum Sorter to cryo electron microscopy, which is generally used to study biological specimens in the form of a flash-frozen solution, include its use to recognise protein structures and their properties, thereby providing researchers with improved knowledge of how cells, tissues, and viruses function.

Theoretical assessments were performed of different dose-efficient methods. A new approach was demonstrated for the recovery of protein symmetry and orientation using a very limited dose. We also demonstrated experimentally a special Sorter-related method that is referred to as "computational ghost imaging".

Q-SORT included a comprehensive outreach and dissemination strategy, based on both online and offline engagement. Its objectives were to communicate the Project to the broader public, to spread awareness about excellent EU-funded research, to prime public interest in the underlying physics of the Project, to foster interdisciplinary dialogue between physics and biochemistry, and to promote the project's results and people in the electron microscopy and quantum science communities.

The work performed during the Q-SORT project involved the design and manufacture of some key components of an electron microscope, without having to completely redesign the instrument. Revolutionary miniaturised optics, comprising first electron holograms and then MEMS chips, were introduced to retrofit existing microscopes and to add new potentialities. In this way, a mature instrument (a transmission electron microscope) could be used to measure properties that were not accessible before.

We first concentrated on the sorting and measurement of orbital angular momentum, which is related to the symmetries of proteins, particles, and atomic orbitals. This capability was not previously available in an electron microscope. It soon became clear that a world of new quantities could be measured if the electron optics was designed and built appropriately.

Research into such uncharted territory required redefinitions of the theoretical pillars of microscopy, of electron optics (including the introduction of artificial intelligence to control the optics) and of electron-matter interactions. This is the first project to fully exploit the deep links between electron microscopy and quantum optics.

Q-SORT has demonstrated the application of a new powerful toolbox to cryo electron microscopy (requiring a special modification to an electron microscope that was previously used in material science) and electron energy-loss spectroscopy to develop and apply new concepts in microscopy. Cross-disciplinary interest in the project has provided considerable added value. Suitable interdisciplinary training was provided via webinars and the organisation of advanced international conferences of the highest profile.

The Quantum Sorter is a unique device, the first glint of a profound revolution in the electron microscopy landscape. Q-SORT has provided its first practical demonstration and applications.

In addition to the fact that the OAM Sorter is itself unique, the concept of controlling the electron beam in a versatile manner using MEMS technology in the electron microscope column is changing the face of advanced electron microscopy research. Q-SORT has also pioneered the use of artificial intelligence to solve the complex Q-SORT problem, as well as offering prospects for developing an electron microscope that allows the user to 'navigate' at the atomic scale while a computer takes care of technical complications.

The Q-SORT project has created a new OAM+EELS type of spectroscopy, which allows atomic orbital symmetries -and potentially orbital deformation due to chemical bonds and magnetic states- to be measured. This new ability to control degrees of freedom will be an important toolbox for studies of 2D materials in catalysis and energy storage, as well as for the atomic-scale control of magnetism for applications in quantum computing.

In cryo electron microscopy and studies of dose-sensitive materials, we pioneered computational ghost imaging, which promises to change the way in which objects are imaged by achieving a tradeoff between information and damage.

There is a clear pathway to the commercial development of these ideas. We started the MINEON Innovation Launchpad project and plan to develop further projects, which may involve the creation of a new company fostered by an ongoing collaboration with ThermoFisher Scientific.

The most important legacy of Q-SORT is the establishment of a new research community revolving around quantum electron microscopy and optics. Interactions between scientists in these fields have been fostered by Q-SORT International Conferences. The quantum approach to transmission electron microscopy that has been developed during this project is here to stay. ■

V. Grillo

e-DREAM, a tool to promote cooperation between European-level advanced electron microscopy infrastructures

e-DREAM (the **E**uropean **D**istributed **Re**search infrastructure for **A**dvanced electron **M**icroscopy) is being established as a non-profit initiative. Its founding members are: Forschungszentrum Jülich, CEMES/LPS-CNRS, Norwegian University of Science and Technology (NTNU), Universiteit Antwerpen, University of Oxford, CNR-IOM, Graz University of Technology and Institut Català de Nanociència i Nanotecnologia (ICN2), CSIC and BIST. It works closely alongside the ESTEEM3 project, the European Microscopy Society, the Analytical Research Infrastructures in Europe (ARIE) and other consortia such as Instruct-ERIC.

e-DREAM has been formed to promote cooperation between European advanced electron microscopy laboratories, collaborative research and transnational user programmes. It supports the European electron microscopy community through strategic initiatives, applications for funding for access and joint research and contact to policy makers, politicians, other electron microscopy organisations and other scientific communities. Its specific aims are:

1. Promotion of science with electron microscopy, with the objective of establishing electron microscopy as a brand recognized by stakeholders, and highlighting the scientific, societal and socio-economic impact of science with electron microscopy.
2. Coordination of exchanges with national, European and global organizations and stakeholders (including users and funders), with the objective of contributing to the shaping of future policies.
3. Coordination of technical development strategies to profit from collective expertise and avoid duplication of efforts, with a view to addressing the scientific and societal challenges of the future in the most efficient manner.
4. Joining efforts in expanding existing and supporting new user communities, both by topic and by geographical origin, with the objective of strengthening Europe's electron microscopy expertise.
5. Promotion of access, based on the principles of the European Charter for Access to Research Infrastructures, with an emphasis on standardization for an improved user experience.
6. Achieving greater coherence in the development of data policy, data handling, data storage, data analysis and data access along FAIR principles, and promoting open science, while protecting intellectual property rights.
7. Coordination of training activities by facilitating staff mobility, with the objective of facilitating international career paths and developing skills in electron microscopy.
8. Facilitating industrial access and collaboration, with the objective of fostering innovation within the European Research Area and the common market for the benefit of society.

In order to achieve these aims, it has established four working groups:

- **European strategy** to address short-term and long-term perspectives and sustainability for electron microscopy in the European landscape of research infrastructures.

e- DREAM
EUROPEAN DISTRIBUTED RESEARCH INFRASTRUCTURE FOR ADVANCED ELECTRON MICROSCOPY

- **Data policy** to address data management, storage, access and file formats, with a focus on open science.
- **Software** for data acquisition, analysis, simulation, instrument control and remote access.
- **Hardware** standardisation of instruments to improve interoperability of multi-vendor and self-made equipment to enable an open ecosystem that fosters innovation.

In 2021, **e-DREAM** participated in five European Union proposals addressing Horizon Europe scientific missions and undertook discussions with policy makers and politicians on the positioning of electron microscopy in the work programme for research infrastructures in Europe and in national roadmaps.

For further information, please visit the **e-DREAM** website (*e-dream-eu.org*) or contact the **e-DREAM** executive assistant Markus Schmitz at *info@e-dream-eu.org*. ■

Rafal. E. Dunin-Borkowski, Etienne Snoeck, Mathieu Kociak, Randi Holmestad, Johan Verbeeck, Angus Kirkland, Regina Ciancio, Gerald Kothleitner and Jordi Arbiol

ESTEEM3: enabling science and technology through European Electron Microscopy

ESTEEM3 is an integrated infrastructure network of **European Electron Microscopy Facilities** providing **Transnational Access** for academic and industrial research communities in materials, physical, chemical and life sciences to the most powerful electron microscopy instrumentation and techniques available at the nanoscale. Coordinated by **Prof. Dr. Peter A. van Aken**, from the Max Planck Institute for Solid State Research in Stuttgart, Germany, the project has a term of four and a half years, from **January 2019** to the end of **June 2023**, and is a follow-on-project of ESTEEM and ESTEEM2.

The project offers researchers in the private or public sector worldwide free **Transnational Access** to the best facilities and expertise in electron microscopy for the study of materials. Applications can be submitted online to **https://www.esteem3.eu** for one of the **15 laboratories** in Europe, where applicants can request access to laboratories located in a different country than the applicant institution.

ESTEEM3 member laboratories **and especially SMEs** (Attolight, CEOS, DENSsolutions and Nanomegas) also develop **Joint Research Activities, with so far more than a hundred published manuscripts**:

- one axis is to develop *new techniques* in electron microscopy,
- a second axis is devoted to the study of *materials for ICT*, *energy*, *health* and *transport*,
- and a third axis concerns *automation* and *big data*.

Additionally, ESTEEM3 deploys an **education and training** component by organizing schools, workshops and webinars as **Networking Activities**, where upcoming events are announced at the ESTEEM3 webpages **https://www.esteem3.eu/news** and **https://www.esteem3.eu/Upcoming-events**.

In 2021, ESTEEM3 has so far provided access to more than 300 projects, and many successful projects were realised through the **Transnational Access**, which shows the necessity towards access to TEM infrastructures in Europe and proves that ESTEEM3 is still a solid network to support the European electron microscopy community.

ESTEEM3 is also leading excellent **Joint Research Activities.** For example, the LiberTEM project led by the Ernst Ruska-Centre for Microscopy and Spectroscopy at the Forschungszentrum Jülich (Germany) aims to work on the development of standardised interfaces for high-throughput distributed live data processing to make microscopy using advanced high-performance computational methods as intuitive, interactive, and easy to use as conventional microscopy.

Finally, ESTEEM3 has participated in major events such as the international Microscopy Conference and still plan to organise other events such as the **Quantitative Electron Microscopy 2022 school**, from 8 to 20 May 2022, in Port Bacarès (France).

To stay informed or join our community, subscribe to our newsletter at **https://www.esteem3.eu/Newsletters** for more other information on results, trainings, transnational access and more.

More information is available on our **website** or **social media** (Linkedin: **https://www.linkedin.com/company/esteem3/** or Twitter: **https://twitter.com/Esteem3Project**) ! ■

Peter A. van Aken

IN MEMORIAM

Remembering two giants of microscopy: Elmar Zeitler (1927–2020) and John Spence (1946–2021)

Two giants of the world of electron microscopy have left us.

ELMAR ZEITLER

Elmar Zeitler died in December 2020 after a lifetime spent working on microscopy, in both the life and the physical sciences. A spell in the Institute for Cell Biology of the Karolinska Institute in Stockholm (where he met his first wife) and a later appointment as Assistant Chief at the Air Force Institute of Pathology in Washington nicely complemented his degree in Physics from the University of Würzburg and generated papers with Günther Bahr (his future brother-in-law) on the quantitative interpretation of electron micrographs.

His interest in both areas continued when he moved to the University of Chicago, where he held professorships in the departments of Physics and Biophysics. Albert Crewe had recently published the first results obtained with the STEM and with Michael Thomson, Zeitler published the first full study of image formation in this new addition to the electron microscope family.

The most lasting result of the Chicago years was the launching of a new journal, *Ultramicroscopy*, designed to attract papers on electron optics, microscope instrumentation and methods. The first issue appeared in 1975 and it rapidly became the leading periodical in the field. Judith Reiffel, Zeitler's secretary, has left a memorable description of the negotiations with H. Wimmers of the North-Holland Publishing Company, part of which is reproduced in Zeitler's obituary in *Ultramicroscopy* (**229**, 2021, 113366).

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Elmar Zeitler

In 1977, Elmar Zeitler was chosen to succeed Ernst Ruska as Director of the Fritz-Haber-Institut of the Max-Planck-Gesellschaft in Berlin. During his years there, he encouraged and participated actively in many advanced research projects, with especial interest in low temperature work; he was convinced that cryo-electron microscopy was the only way of combating radiation damage in biological specimens. As he observed, thinking on the subject divides naturally into two groups, "one being concerned with what the instrument does to the electrons and the other being concerned with what the electrons do to the specimen".

Even after retirement in 1995, Zeitler continued to interest himself in the research projects of the Institute until 2012, when he was a victim of a stroke. Among his many honors, he received the Distinguished Scientist Award (Physics) of the Electron Microscopy Society of America in 1989. He was president of the International Federation of (Electron) Microscopy Societies from 1982–1984.

John Spence, Thanks to Peter Hawkes

John Spence

His friend and colleague Robert Schlögl writes "His cooperative and outwardly modest manner may have detracted from the appreciation of his merits but the scientists of electron microscopy and all who worked with him will cherish his memory". Professor Schlögl's full obituary can be read on the Fritz-Haber-Institut website (fhi.mpg.de).

This accomplished physicist and stimulating companion died in his sleep on 19 December 2020.

JOHN SPENCE

John Spence shared Zeitler's interest in both areas of electron microscopy. For many years concentrating on the study of materials and especially of crystalline specimens, he later became fascinated by the biological applications of x-ray scattering, made possible by the development of the x-ray free-electron laser. He pioneered the policy of Diffract-and Destroy, whereby a vast number of diffraction patterns are

recorded very rapidly, before the radiation has time to damage the specimen. In addition to his professorship at the University of Arizons, he was appointed Scientific Director of BioXFEL Science and Technology Center, a consortium of seven American laboratories using hard x-ray lasers in structural biology.

John Spence was born in Australia, where he passed his PhD under Alan Spargo at the University of Melbourne. He then joined Professor Hirsch's group in the University of Oxford, where his interest in electron scattering in crystalline materials was first awakened. It continued for the rest of his life and his final publication with Jeffrey Donatelli, "Inversion of many-beam Bragg intensities for phasing" (*Phys. Rev. Lett*. **125**, 2020, 065502), is a triumphal swan song. In 1976, he joined fellow-Australian John Cowley in the University of Arizona in Tempe, where he worked on some of the most challenging problems of image formation and interpretation in materials.

But not all his time was spent on microscopy. He was a talented musician: his recording of Chopin's Fantaisie-Impromptu was played at his funeral service. And classical music was not all. Before leaving Australia, he was a folk-singer in company with Olivia Newton John, before her Hollywood days, and in Arizona, he was the guitarist in the MoonDogs band. Later Who Knew provided the musical background to numerous physics conferences. He also found time for sailing and gliding; he gained his glider pilot's license in 2009. He came from a family of aviators: his father, killed in action at the age of only 33, was a fighter pilot and his maternal grandfather flew Sopwiths in the Royal Flying Corps in WW1.

John was author or co-author of several works. His book on high-resolution electron microscopy went into four editions and the volume on *Advanced Transmission Electron Microscopy* by J.-M. Zuo and John Spence is a major contribution to the subject. He and I edited *Science of Microscopy* and the *Springer Handbook of Microscopy*. More recently, he turned to the history of science with a readable and erudite account of the measurement of the speed of light, *Lightspeed*. And, shortly before he died, he had the pleasure of seeing *Spitfire Pilot*, based on his father's wartime diary and letters sent home from Tobruk.

John's work was recognized by many honors, of which the most prestigious is Foreign Membership of the Royal Society, closely followed by honorary membership of the Royal Microscopical Society, Corresponding (Foreign) membership of the Australian Academy of Sciences and, like Elmar Zeiler, holder of the Distinguished Scientist Award (Physics) of the Microscopy Society of America; he was a visiting Fellow of Churchill College, Cambridge. His many qualities were movingly evoked at the (virtual) PICO meeting, "Frontiers of Aberration-corrected Electron Microscopy in May 2021 (*Ultramicroscopy* **231**, 2021).

This charmer of so many talents died on 29 June 2021. ■

Peter Hawkes

Remembering Dr. Árpád Barna (1935-2021)

Dr. Árpád Barna, or "Árpi uncle" as he was called by many of us, in his 86th year, on the evening of September 24, 2021, died.

We mourn the Candidate of Physical Science, the Doctor of Engineering, and first of all, our role model.

Árpi and his colleagues started in-situ transmission electron microscopy in 1966, of which the hardware was implemented by him. In the TEM, up to two elements could be evaporated, particle growth observe, Hall resistance measured. Later, he developed all the tools needed for TEM sample preparation. He created several types of ion guns and ion beam sample thinners, the complete sample preparation process and know-how, and became one of the authors of the Handbook of Microscopy.

He was a genius engineer, an excellent scientist, always a helpful and generous colleague, the young and we all learned a lot from him.

We don't want to and cannot forget him we preserve his memory. ■

Béla Pécz,
board member of HSM,
Director of Centre for
Energy Research, Eötvös
Loránd Research Network

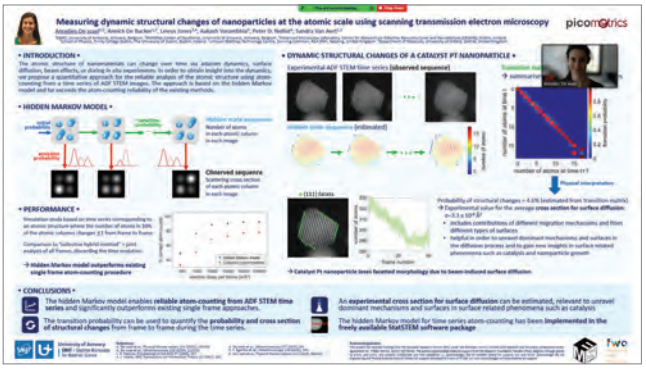
The HSM decided to establish a Barna Árpád Prize to preserve his memory.

The award will be dedicated to those whose creativity and achievements in the field of electron microscopy would be recognized by him, too.

Dr. Árpád Barna

EMS Scholarships report

Annelies DE WAEL

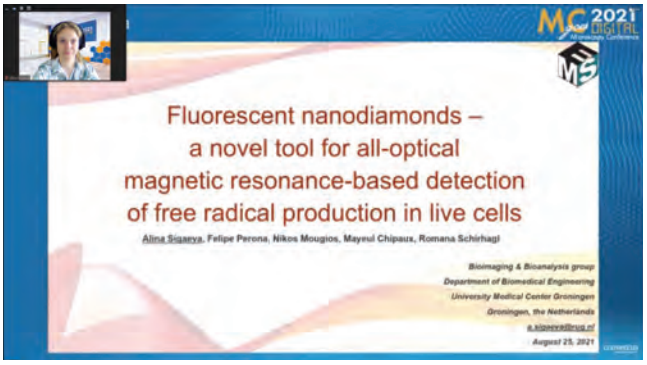


I would like to take this opportunity to thank EMS for their financial support, enabling me to take part in the Microscopy Conference 2021 (MC2021), which took place online as a result of the current situation. This was my last conference as a PhD student, and a very good practice for my defence which took place on the Monday after the conference. During the poster session, organised with individual break out rooms, I had the opportunity to meet a lot of interesting people and have very real interactions. As such, the online meeting was a success as far as I'm concerned. Furthermore, I could easily follow talks on the hot topics and challenges in today's electron microscopy research via the different online streams which were easily accessible.

I presented my research on a novel method for atom-counting I recently developed through a poster entitled "Measuring dynamic structural changes at the atomic scale using scanning transmission electron microscopy". The online poster presentation was a very nice experience for me, and two short hours flew by very quickly while I was discussing with interested researchers.

In short, MC2021 was a great learning opportunity for me and I look forward to the next conference, which can hopefully take place in person, rather than online! ■

Alina SIGAEVA



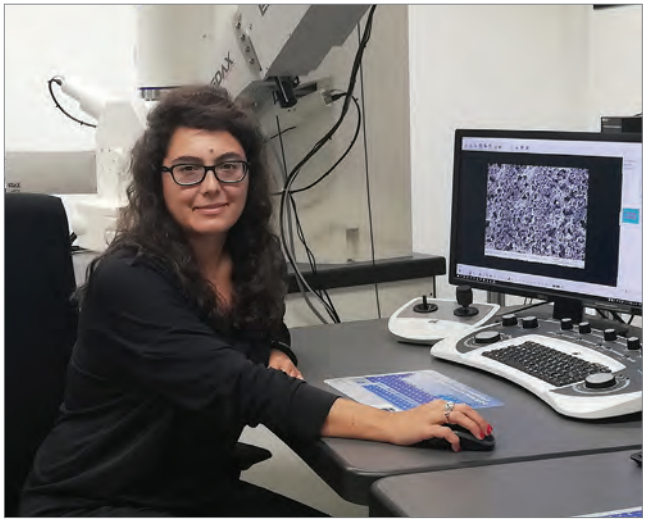
This year's Microscopy Conference (MC2021) meeting has once again brought together scientists from various fields of microscopy to share their expertise and present the latest developments in the topic. Organized by ten microscopy societies, representing eleven countries, it has been a truly international event. The plenary lectures were interspersed with oral and poster presentations from the participants, including early-career researchers, and supplemented with the talks and exhibitions by the commercial partners – the leaders in the field of microscopic instrumentation. The four-day schedule, from August 23rd to August 26th, was full of both scientific and social activities, and the organisers have done a fantastic job, overcoming the additional hurdles of the online format to host an extremely successful conference.

The range of topics covered during the conference was truly impressive, from the talks on the current developments in microscopic instrumentation and methods, all the way to the applications of those in materials and life sciences. As the participants' areas of expertise were extremely diverse, it allowed for fascinating inter- and multidisciplinary discussions, with different experts offering different perspectives on the topic. The ever-present spirit of collaboration across the borders of countries and scientific disciplines made MC2021 an outstanding event. Social activities, such as meeting each other in a virtual gathering room, provided additional networking opportunities.

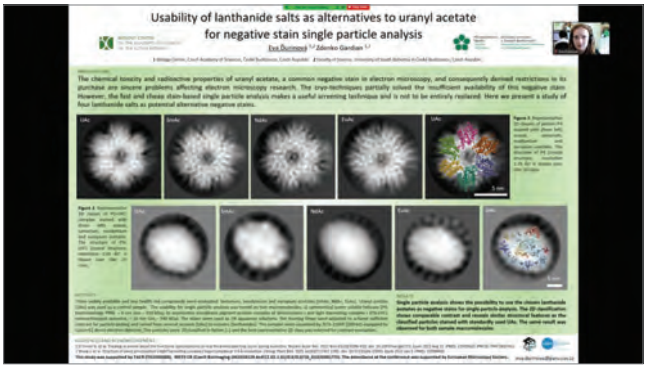
The organizing team did an excellent job at translating the meeting into the virtual format. Everything ran smoothly, and there was always someone to assist with any technical difficulties. Overall, the event was a great success, and it was a great opportunity to meet and interact with fellow researchers, passionate about the various facets of microscopy. I am definitely looking forward to seeing everybody again (hopefully, in person!) at the next Microscopy Conference, which will take place on February 26th-March 2nd 2023 in Darmstadt, Germany. ■

Pinar KAYA

The Microscopy Conference 2021 (MC2021) was held from 22nd-26th August on the digital platform. Although the MC2021 was not an in-person meeting, we could still get the opportunity to virtually discuss with the experts of electron microscopy as well as other young scientists from all over the world. I am honored to be awarded the European Microscopy Society (EMS) scholarship to attend such a great conference and present our recent results on "Microstructural Investigations on Selectively Laser Treated Li6.4La3Zr1.4Ta0.6O12 (LLZTO) Solid Electrolyte". I have also visited the well-organized virtual exhibition hall, where the new developments from the companies were nicely presented. As a materials scientist and electron microscopist, my research focuses on the microstructure-property relationship in materials for energy conversion and storage applications. In this meeting, I enjoyed the broad scope of the symposiums with presentations both far outside my own field and others very specialized in techniques relevant to my work. Moreover, I was delighted to receive the third prize of the Best Image Contest in the category Art in science at MC 2021. Therefore, I would like to thank EMS for the financial support that enabled me to participate in MC2021 and thank the organizers for an excellent online meeting. ■



Eva ĎURINOVÁ



I am a third year PhD student at the Faculty of Science, University of South Bohemia and a member of the Laboratory of Electron Microscopy at the Biology Centre of Czech Academy of Sciences in České Budějovice, Czech Republic.

I would like to thank the European Microscopy Society for funding my attendance at the Multinational Congress on Microscopy 2021. It was my first experience with a large online meeting. Although I enjoy the possibility of meeting other researchers and fellow students in person, I appreciated the well-organized online version in this difficult time of the pandemics.

At MC2021, I presented a poster about one of my projects focused on improving technical parameters of a method important for studying the structure of a macromolecule by cryo-EM (which is my field of study). This project showed to be interesting for other microscopists struggling with finding an alternative to widely restricted uranyl acetate. The title of my poster was „Usability of lanthanide salts as alternatives to uranyl acetate for negative stain single particle analysis" and I presented results showing the three tested compounds as health risk-free and well-usable negative stains. My poster was scheduled for the IM5 ePosters section on Wednesday 25th August and I was glad to meet several researchers in an online discussion.

I attended many interesting lectures and talks throughout the conference, many of them focused on studying SARS-CoV-2. I wish that the amazing development in this field of study will help to get the situation closer to normal next time and am looking forward to meeting all of you at the next conference in person. ■

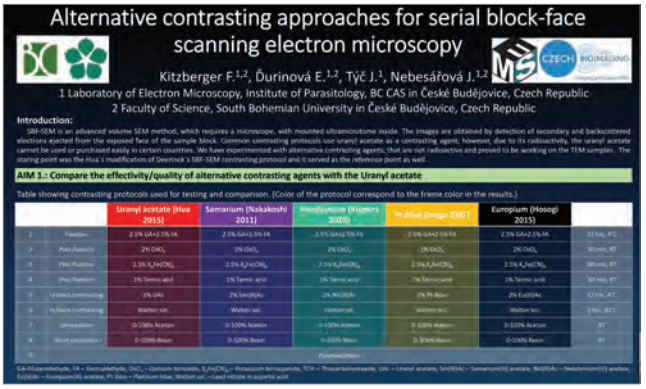
Tiarnan MULLARKEY

My name is Tiarnan Mullarkey, a PhD student in the Ultramicroscopy Group at Trinity College Dublin, and I would like to begin by thanking the European Microscopy Society for supporting my attendance to the Joint Meeting of Dreiländertagung & Multinational Congress on Microscopy / Microscopy Conference 2021 (MC 2021) held on August 22-26, 2021. As an early career scientist it is very important that I can attend conferences to share my work and build connections, and so I am extremely thankful that this scholarship allowed me to attend this excellent conference.

At this (virtual) conference I presented a poster titled "Expanding Performance and Usability of High-speed / Low-dose STEM Scanning" which focused on my recent work on not only getting more out of our instruments at low-doses, but also making them easier to operate in these conditions. I was delighted with the response and the discussions I had with people from a wide variety of disciplines which made for some very interesting and valuable conversations.

I would like to commend the organisers for making the online platform entertaining and enjoyable to navigate, with the song on the home page and the "Passport to Vienna" quiz being great touches. And of course, not to forget the fantastic scientific contributions from the attendees and invited speakers. I eagerly await the next conference and hope to see some now-familiar faces there! ■

Frantisek KITZBERGER



As a PhD student, I am quite a newbie to electron microscopy, as I came from the protein NMR field (my bachelor and master thesis focus). The MC2021 was my first international conference in this field, and I am really glad to attend. Unfortunately, it was also necessary to be held in the online form only. Therefore, I thought that the atmosphere of meeting and interacting with people would be missing. However, I was nicely surprised. The get-togethers, which are in my opinion the crucial part of the live conference, as one can just sit and talk with the lecturer at the table about the common topic of interest, were held in an "online pub" where you as a "game character" could actually wander around and sit and talk with whoever you wanted. This was a really great idea, as it gave you the feeling of being at the live conference.

Now to the conference itself. I had the opportunity to see many interesting lectures and presentations, including those of my field of interest, and widen my knowledge in other areas. I had a chance to see a couple of presentations organized by microscopic companies focusing on their new technologies/machines and advances. I was happy to present the results of my research of alternative contrasting possibilities for SBF-SEM sample preparation as a poster.

I would like to thank the EMS for granting me a scholarship to attend this conference. I was glad to participate, and I am looking forward to the next one, hopefully, live one, to meet all these great people in person. ■

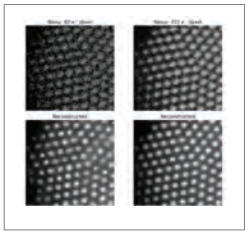
Laura GAMBINI

My name is Laura Gambini and I'm a PhD student at Trinity College Dublin, in the Computational Spintronics Group. It was a great pleasure to participate in the Joint Meeting of Dreiländertagung & Multinational Congress on Microscopy, held online on 22-26 August 2021.

I would like to thank the organizers of this event, which offered a variety of interesting and stimulating talks from experts in the field of microscopy from around the world.

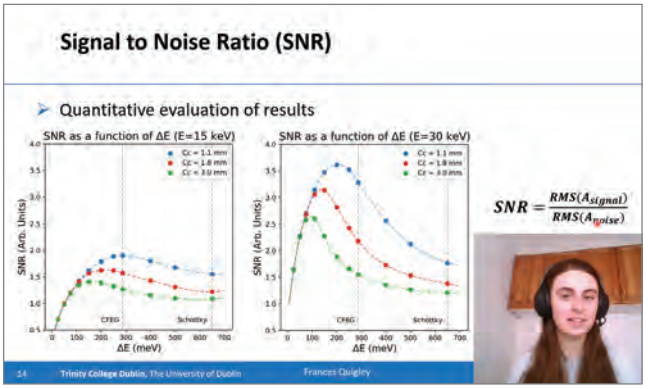
During the conference, I had the opportunity to present my work in a poster session. It was a great opportunity to have interesting conversations with people of this scientific community and I received useful feedback and suggestions for my PhD project.

The work presented in my poster involves a machine-learning approach for resolution enhancement of low-dose STEM data. In particular, I trained a neural network, known as autoencoder, on a set of simulated STEM images, including different materials and a wide range of doses. The neural network was trained to remove Poisson noise, an effect related to the quantised nature of the electron beam, which cannot be corrected at the instrumentation level. The model was validated with tests conducted on simulated and experimental images. An example of reconstruction can be seen in the attached figure, which shows the reconstruction of experimental images of a Gold nanoparticle deposited on an amorphous Carbon substrate, at different dose levels.



I would like to thank the European Microscopy Society that granted me with a scholarship to pay for the registration of the conference. ■

Frances QUIGLEY



My name is Frances Quigley, a second year PhD student in the Ultramicroscopy group in Trinity College Dublin Ireland. Thanks to the European Microscopy Society scholarship I attended the Joint Meeting of Dreiländertagung & Multinational Congress on Microscopy / Microscopy Conference 2021 (MC 2021) from August 22nd - 26th 2021. The conference was extremely interesting and full of very engaging presentations and posters.

My talk was entitled 'The Resolvability of Features at Low Voltage and Low Dose Imaging.' In it I discussed how different objective lenses and beam energy-spreads affect the image quality of a 2D material imaged at low voltages in a spherical aberration-corrected Scanning Transmission Electron Microscope (STEM), in the context of the economic feasibility of the instrumentation. This pre-recorded talk was presented in the 'Advances of electron optical instrumentation' session and I was delighted with the audience's engagement during the live Q and A section.

While it was unfortunate that MC 2021 could not have been in person, the conference took advantage of its well set up virtual platform for the talks and the poster sessions. It was particularly enjoyable to engage directly with the poster contributions via the breakout rooms, and the chairs of the many different sessions were excellent at keeping the audience engaged through the Q and A portions. I would like to thank the European Microscopy Society for supporting me to attend this conference as well as the organisers of MC 2021 for the opportunity to present my research. ■

Isaak VASILEIADIS

First, I would like to thank the **European Microscopy Society (EMS)** for the scholarship that allowed me to participate at the *Joint Meeting of Dreiländertagung & Multinational Congress on Microscopy/ Microscopy Conference 2021 (MC2021)* which was held virtually on 22-26 August 2021.

My contributions to *MC2021* were at the sessions of *"Open Topic 2: Electron irradiation effects in transmission electron microscopy"* and *"Materials Science: Electron microscopy breakthroughs in the study of low-dimensional materials"* by presenting projects from my PhD research. In the first session, I had an oral presentation with the title *"Core structure and mobility of Shockley partial dislocations in GaN by aberration-corrected HRTEM"* showing the results of an atomic-scale analysis of partial dislocations' mobility promoted by electron beam irradiation, as given in our recent research work (**https://doi.org/10.1063/1.5121416**).

My contribution to the second session was in the form of a digital poster entitled *"Aberration-corrected STEM analysis of monolayer-thin InGaN/GaN quantum wells"* describing a methodological approach of quantitative STEM analysis of extremely thin quantum wells which was employed in our recently published research paper (**https://doi.org/10.1038/s41598-021-99989-0**). At the end of the conference, my poster was distinguished as one of the Best Posters in the *Materials Science* section.

Plenary lectures and oral presentations in the conference were very interesting covering a wide range of novel microscopy techniques, their possible applications, and future challenges. The *e*Poster sessions, with a breakout room for each poster, offered a great "virtual environment" for discussions allowing a direct interaction between presenter and participants. Alongside the scientific presentations, several industry lectures given by experts from leading companies in the field of electron microscopy enriched the conference program by highlighting their latest advancements in instruments, technical applications and innovative software tools. Meanwhile, the availability of the congress material after the conference was an important and welcomed initiative giving the opportunity to attend high quality talks that were overlapped during the conference.

Finally, I would like to thank again the **EMS** for the financial support and congratulate the Organizing Committee of *MC2021* for the excellent organization of the conference. ■

Financial report of EMS budget

European Corporate member assembly (ECMA)

European Microscopies Societies

Reports from national and regional societies

Outstanding Paper Awards for 2020

EMS Calendar 2022

Application for membership

Financial report of EMS budget

To be presented at the virtual EMS GA, August 24, 2021.
Budget 2020 final, overview budget 2021 and proposal budget 2022

Budget 2020, final

Incomings

The majority of incomings came from contributions of the national societies and the ECMA members with further incomings from individual members, interest rates and from job postings for non-EMS members. Furthermore. In summary, an amount of **€ 48 151.87** was accrued.

Expenses

EMS supported the virtual EMC with **€ 18 000** to reduce fees for young scientists (replacing scholarships). Only one supported meeting took place in presence mode **(€ 750)**. Two board meetings, one GA and one GC took place.

Costs for organization of virtual meetings, for professional secretarial support and for three Outstanding Paper Awards added up to **€ 35 516.58**. Together with further costs (banking, web hosting, flyers etc.) EMS had total expenses of **€ 56 769.67**. Thus, the annual balance for 2020 ended with a minus of **€ 8 617.80**.

As a matter of fact, our bank closed our deposit account of **€ 70 258.44** and the amount was transferred to the giro account. As of December 31st, EMS had total assets of **€ 109 446.03.**

Budget 2021, running; (as of July 26, 2021)

Incomings

The major revenues will again be accrued by the annual contributions of EMS members of the national societies and of ECMA members. Invoices to national societies, ECMA members and individual members had been sent out in March and April, reminders to ECMA in July and reminders to national societies will be sent out in September latest. Further incomings will be accrued by individual member fees and job postings for non-EMS members.

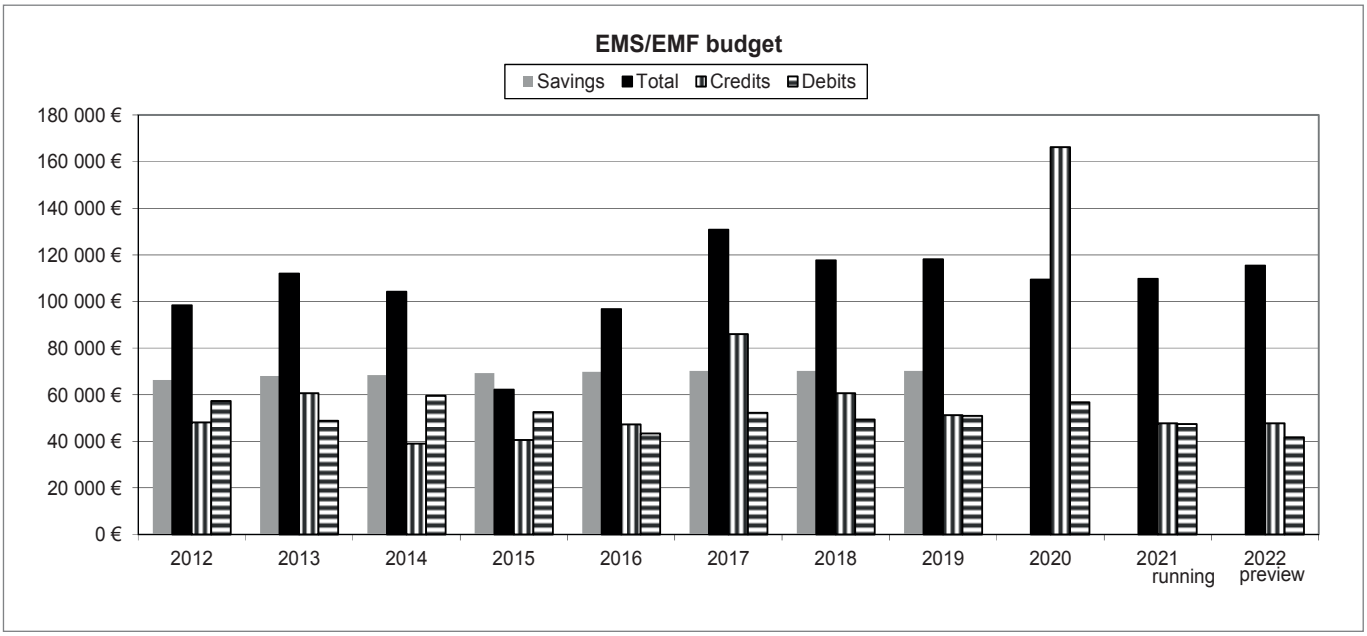
Together, incomings are expected to amount to **€ 47 700**.

Expenses

EMS supports one extension meeting (MC2021) and sponsors 5 supported meetings (together **€ 5 250**). EMS distributes 26 scholarships to young colleagues to cover attendance fee for MC2021 (á € 190, together **€ 4 940**). Further expenses will include the Outstanding Paper

Awards (**€ 3 000**), board and GA meetings (this one and several online meetings), professional secretarial support and bank costs. Expenses are estimated to amount to **€ 47 700**. It is thus calculated to end the year 2021 with a balanced budget.

Table EMS budget development/10 years



Budget 2022, proposal

Incomings

Major incomings will be accrued by the annual fees of EMS members of the national societies and of ECMA members. Together with interest rates of the savings account and advertising for non-EMS members, we can expect incomings of **€ 47 800**.

Expenses

One EMS extension meeting can be supported due to postponement of IMC20 to 2023 (**€ 1 500**). EMS can further support up to 4 sponsored meetings (**€ 3 000**) and reserves **€ 3 600** for support of young scientists at meetings issued either as travel grant or for online attendance fees. Further expenses will include the Outstanding Paper Awards, costs for professional secretary, two board meetings and bank costs, amounting to a total of estimated **€ 41 700**.

It is thus calculated to end the year 2022 with a plus of **€ 6 100**. The surplus is intended to be spent for travel scholarships to IMC20 in 2023.

Annotations:
The risen Credits bar in 2020 is due to transfer of all savings to the giro account; note that Credits and Debits exclusively depict annual budget figures without overflows; Total includes overflows and shows figures at the end of the year; Savings in previous years depicts the part of the Total that was on the previous savings account. ■

Christian Schöfer, m.p.
Treasurer EMS/EMF

Vienna, July 26, 2021

Corporate members 2021

PLATINUM MEMBERS

- Diatome Ltd
- JEOL Europe
- Thermo Fisher Scientific
- TESCAN

GOLD MEMBERS

- Andor Technology
- DELONG INSTRUMENTS a.s
- Hitachi High-Technologies
- Leica Microsystems
- TVIPS - Tietz Video and Image Processing Systems

SILVER MEMBERS

- AMETEK B.V.
- Bruker Nano GmbH
- Carl Zeiss Microscopy GmbH
- CEOS
- DENSsolutions
- Electron Microscopy Sciences
- Intelligent Imaging Innovations GmbH
- NanoMEGAS
- Quorum technologies
- SPI Supplies
- Ted Pella, Inc.
- XEI Scientific Inc.

BRONZE MEMBERS

- 3D-Micromac AG
- Advanced Microscopy Techniques
- Deben UK Ltd
- Digital Surf
- EMSIS GmbH
- Eumex Instrumentebau GmbH
- Fischione Instruments
- FemtoTools AG
- Gammadata Instrument AB
- Gatan
- ISS Group Services Ltd
- Klocke Nanotechnik
- LAB PROTECT – Electron Microscope Protection
- MICROS Austria Produktions- und Handelsges.m.b.H
- Micro to Nano
- NANOVIZZ
- NenoVision
- Protochips
- Safematic GmbH
- Schaefer Technologie GmbH
- Science Services GmbH
- SmarAct GmbH
- Systron EMV GmbH

Please find more information about the corporate membership fees:

https://www.eurmicsoc.org/en/organisation/corporate-members-ecma/concept-constitution-fees/

European Microscopies Societies

Number of EMS Members by Societies (2021)			
National and regional societies			**# of members**
Armenian Electron Microscopy Society	(AEMS)	Armenia	8
Austrian Society for Electron Microscopy	(ASEM)	Austria	185
Belgian Society for Microscopy	(BSM)	Belgium	321
Croatian Microscopy Society	(CMS)	Croatia	115
Czechoslovak Microscopy Society	(CSMS)	Czech Republic	231
Dutch Society for Microscopy	(NVvM)	Netherlands	224
Electron Microscopy and Analysis Group (Institute of Physics)	(EMAG)	United Kingdom	314
French Microscopy Society	(SFμ)	France	425
German Society for Electron Microscopy	(DGE)	Germany	436
Hellenic Microscopy Society	(HMS)	Greece	36
Hungarian Society for Microscopy	(HSM)	Hungary	86
Israel Society for Microscopy	(ISM)	Israel	118
Italian Society of Microscopical Sciences	(SISM)	Italy	191
Microscopical Society of Ireland	(MSI)	Ireland	65
Nordic Microscopy Society	(SCANDEM)	Scandinavia	199
Polish Society for Microscopy	(PTMi)	Poland	149
Portuguese Society for Microscopy	(SPMicros)	Portugal	30
Romanian Electron Microscopy Society	(REMS)	Romania	72
Royal Microscopical Society	(RMS)	United Kingdom	1422
Serbian Society for Microscopy	(SSM)	Serbia	92
Slovene Society for Microscopy	(SDM)	Slovenia	114
Spanish Society for Microscopy	(SME)	Spain	296
Swiss Society for Optics and Microscopy	(SSOM)	Switzerland	78
Turkish Society for Electron Microscopy	(TEMD)	Turkey	45
Russian Society of Electron Microscopy	RSEM	Russia	20
Total			**5272**
Corporate members EMS (44 companies)	(ECMA)		36
Individual members	IND		15

Reports from national and regional societies

Czechoslovak Microscopy Society (CSMS)

The Czechoslovak Microscopy Society was active in 2021 despite the Corona Virus pandemic. At the end of the summer the CSMS held a regular annual conference "Microscopy 2021". The meeting was organised in the conventional personal form in the date September 13th-15th, 2021 in the Biology Centre of the CAS / the University of South Bohemia in České Budějovice. More than a hundred members attended the conference including also a corporate exhibition involving 15 companies. Ondrej L. Krivanek (Nion, USA) received the CSMS award for merit in microscopy.

To mark the occasion, he gave an impressive online lecture "Resolution revolutions in transmission electron microscopy". Two prizes for young scientists were also announced, provided annually by Thermo Fisher Scientific/ CSMS and CSMS. These prestigious scholarships received Daria Drozdenko, postdoc from Charles University, for the project named "Application of advanced *in situ* techniques for investigation of plastic deformation of Mg alloys" and Václav Bačovský, postdoc from Biophysical Institute of the Czech Academy of Sciences, for the project named "The cessation of recombination and its origin between evolutionary young sex chromosomes in *Silene*".

The Czechoslovak Microscopy Society (CSMS) together with the other seven European societies within the MCM club is organizing the 16th Multinational Congress on Microscopy in Brno, Czech Republic. The conference is scheduled for September 4th-9th, 2022. It was recently selected by the European Microscopy Society as the EMS Extension for 2022. MCM conferences have a long tradition and cover all microscopy fields, focusing mainly on electron microscopy. Three parallel sessions for Instrumentation & methods, Life sciences and Material sciences are planned as usual. The location in Brno is an ideal place for electron microscopy events because it has a long tradition in the development and production of microscopic instruments as well as a couple of universities and research centres performing a great science in various fields connected with light and electron microscopy.

Thanks to the combination of collaborations between the industry and academia, it was possible to create a functional electron microscope ecosystem. Therefore, CSMS believes that the meeting will be an excellent opportunity to present significant scientific results and new ideas in the field of microscopy. The quality of scientific content will be ensured by leading scientists from across Europe. The attendance of young scientists and students will be supported by proving low conference.

More details about the upcoming event is available at the website **www.16MCM.cz**. ■

Hungarian Society for Microscopy (HSM)

For the last two years, most of our colleagues have seen each other only on screens, unless they did not work in the same workplace. We had high hopes till springtime that at least MC 2021 in Vienna in August can be held live, but the Organizers had to transform it into an online event. Thanks to their hard work and high imagination, the event was excellent.

Our annual HSM conference in May had also to be online. It was successful, and the program included even a virtual wine tasting. The selected wines were sent to the members of HSM in advance by the organizers, so no one had to listen to the introduction of the wine with a dry throat. By the end of the night, an initiative was born thanks mainly to Miklós Soós (Auroscience) and we agreed to organize a one-day conference in the fall. It would start at noon to make it possible for everybody to arrive in time from the different parts of the country and the scientific program would start after lunch. Of course, a wine tasting program was also planned and the payment of its cost was offered by Miklós.

In our hotel at Lake Balaton, instead of a sunny October, we only got a date for the foggy November . However, we were lucky, although Thursday was not so sunny by noon either, on Friday everyone could start home after lunch in bright sunshine.

Zoltán Kristóf and Béla Pécz organized the program, László Barna provided great help with his valuable knowledge of where there are labs excels in using microscopy and where we can find techniques and methods worth learning in Hungary, and Kati Balázsi worked tirelessly to collect the registrations, writing and many times canceling the invoices when she got wrong addresses and negotiated with HSM sponsors. The hotel also pitched in a bit, reducing the 100% penalty for its long-time guest for a couple of late cancellations.

How was the conference itself? Good atmosphere, relaxed but not disjointed. Two of our speakers of 14 delivered their talk via Zoom only, but it worked well and following the talks we showed our lecturers their audience, too.

Anyone can say, this all was not a big deal, today it is the new norm! However, I believe our case was special. Naturally, no one could register the program without vaccination (at least two shots) but vaccination certificates were not enough. The fact that everyone can only occupy the room after a fresh negative test was a very useful idea of Zoli Kristóf and Miklós Soós. And Miklós Soós even did more than just carry tests and hand sanitizers. (Sanitizers were at hand in several places in the hotel and the auditorium was ventilated through large doors opening to the outside.) He even brought a professional device to sanitize the lecture room with H2O2 vapor before the first lecture and during the break between the 2-hour lecture blocks!

These circumstances helped a lot to feel being protected compared to the current conditions and could listen with full attention to the microscopists from all over the country, from Miskolc to Pécs, from Szeged to Veszprém. Even a new collaboration has started. The wine tasting was also well attended, of course.

Everyone was obviously happy to be there, and all of us hope to see each other again next spring without so many rules and preparations.

And I have to add something: Kristóf Kovács who gave an excellent presentation on 12 November in Siófok, was awarded the Trefort Ágoston Prize by Minister of Innovation and Technology László Palkovics in Budapest for his outstanding teaching activities on Monday 15 November, on the Hungarian Higher Education Day. "The Trefort Ágoston Prize is awarded to those working in state and church-run institutions who have done outstanding work in the field of education over a long period of time."

Even a minister can be right. ■

Israel Society for Microscopy (ISM)

The Covid-19 pandemic has put heavy restrictions on social gathering and activity during the past couple of years. During this period the Israel Society of Microscopy (ISM) decided to launch a virtual social activity for all researchers in the microscopy field. Over 40 researchers from all the Israeli academic institutes and over 100 art pieces were collected and the event was launched on the 1st of Jan. 2021. Link is here: **www.ismicroscopy.org.il/ism-art-exhibition**

The art exhibition, which includes microscopy micrographs and paintings, originates from the eyes of researchers, which are using a variety of microscopy methods (optical, electron, scanning probe). The main exhibition aspects include deep exploration into the materials and methods, showing physical biological concepts behind the scientific work as well as some historical background of microscopy. The modification of scientific work to artwork provides the linkage between the scientific world and the real life macroscopic world. This exhibition thus intends to provide a tight bonding between Microscopy, Art and Social life. Finally, we provide microscopy with a smile!

In Aug. 2021 the virtual art exhibition was transformed to be also in real space with about 30 selected art pieces. This exhibition started at Tel-Aviv University and will move every three months to another academic institute in Israel.

Warm acknowledgements are given to over 40 contributors from all academic institutes in Israel. The ISM art exhibition committee included ISM board members: Dr. Einat Zelinger, Dr. Ifat Kaplan-Ashiri, Dr. Yafit Fleger, Dr. Yaron Kauffmann, Prof. Amit Kohn and Dr. Zahava Barkay.

Based on local and international positive feedback we would be glad to collaborate with additional societies and institutes for organizing international art exhibitions focusing on microscopy. ■

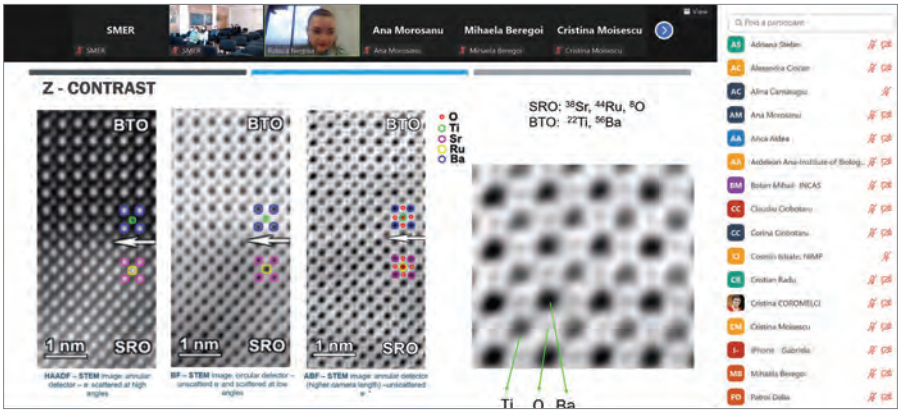
Best wishes,

Dr. Zahava Barkay (ISM Secretary)
E-mail: barkay@tauex.tau.ac.il
Dr. Yaron Kauffmann (ISM Chair)
E-mail: mtyaron@technion.ac.il

Romanian Electron Microscopy Society (REMS)

Despite the prolonged SARS Cov-2 pandemic disturbing human activity in perhaps all the fields worldwide, the Romanian Electron Microscopy Society (REMS) decided it was worth making the necessary efforts to keep uninterrupted the row of biannual conferences organized by our young association. Moreover, we decided to expand this event by adding a school of electron microscopy at an introductory level addressing the youngest members in our society. Therefore, the coupled event including the 4th Conference of the Romanian Electron Microscopy Society, CREMS 2021, and the 1st School of Electron Microscopy has been organized at the National Institute of Materials Physics in Magurele between October 18-22, 2021, with the participation of the "Politehnica" University of Bucharest, National Institute of Pathology Victor Babes, Bucharest and Institute of Biology of the Romanian Academy, Bucharest.

A hybrid format has been adopted for the two events, the participants having the possibility to choose between physical or virtual attendance. The school included introductory theoretical notions covering different electron microscopy techniques of imaging, electron diffraction and spectroscopic investigations in TEM and SEM, for materials and life sciences. Practical sessions have been also organized and made available to all attendees, either in person or online, where various aspects from specimen preparation to their microscopic investigation by several techniques have been presented in detail, in materials and life sciences. They included both pre-recorded short movies and on site demonstrations, webcasted live for the online attendants.



Views from the physical and virtual presentations during the REMS school and conference of electron microscopy.

A number of 45 participants from 8 national research institutes and universities had the opportunity to present their scientific results and exchange ideas during the conference, but also to learn about the latest achievements in the field, as revealed by invited delegates from top manufacturers of electron microscopy gear. An image contest entitled „At the confluence between science and art" has been organized for the student participants, based on TEM/SEM images they acquired. Although taking place in unusual conditions, the two events rejoiced the enthusiastic participation of resourceful young researchers, providing favorable ground for the next edition of the REMS conference and school of electron microscopy to attract an increased attendance, hopefully in normal sanitary conditions. ■

Corneliu Ghica
(President of the Romanian Electron Microscopy Society)

Royal Microscopical Society (RMS)

While 2021 proved to be another difficult year, it was certainly a busy one, with the resumption of many RMS events - albeit in virtual form - and other activities getting back up and running despite the ongoing impact of the Covid-19 pandemic.

With in-person meetings, courses and conferences once again off the menu, the Society delivered more than 20 well-attended online events, covering the full range of microscopy and imaging techniques and applications. We also hosted around 40 Imaging ONEWORLD seminars – an ever-popular series featuring some of the foremost names in microscopical research, and hundreds of attendees logging on to take part from across the globe.

In October, the RMS was particularly pleased to launch the eagerly anticipated International Microscopy Lecture Series - an exciting collaboration between the RMS, The Microscopical Society of Canada and the Israel Society for Microscopy. The initiative is also supported by the International Federation of Societies for Microscopy (IFSM), and we hope to encourage participation from other international microscopy societies in the future.

Over the summer, the RMS hosted two major international events in elmi2021 and mmc2021 – both held virtually for the first time in their history. More than 1,300 attendees logged on from across the world to take part in mmc2021, and more than 600 participated in elmi2021. Both events featured fantastic scientific programmes, online commercial workshops and more.

A bespoke conference website was developed for mmc2021, with an integrated abstract admissions system and live conference streams. In another first for the Society, the event also featured a fully-realised online exhibition with a range of interactive options for delegates and visitors. We'd like to give special thanks to all our mmc2021 and elmi2021 sponsors for backing these virtual events. We simply could not have gone ahead without your support.

We were delighted to see the safe resumption of Outreach and Education activities this year, including the reissuing of our Microscope Activity Kits to primary schools across the UK and Ireland. We are thrilled that primary educators and their classes are once again able to benefit from our flagship scheme.

Another fantastic scheme led by Dr Alex Ball and Dr James Perkins in collaboration with Hitachi now provides access to portable scanning electron microscopes (SEMs) for secondary school pupils. More than 25 schools have already been involved in the programme, either as hosts or through remote access to the microscopes. We very much hope that 2022 will bring more opportunities to take part in in-person Outreach and Education activities.

The Society gave out a number of prestigious awards in 2021, recognising some of the most outstanding achievements from across the microscopy community. Congratulations to all our award-winners, about whom you can find out more at **www.rms.org.uk.**

Meanwhile, we were delighted to award Summer Studentships to six students this year - with one student carrying over their Studentship from last year. Each student received up to £2,000 to cover the cost of their microscopy-related projects, and their reports are due to be published in our forthcoming issue of infocus Magazine. The RMS Diploma also continues to go

from strength to strength, with three new candidates beginning their studies this year, and a total of nine candidates now working towards their qualifications.

On a historical note, an RMS microscope presented to HRH The Prince Philip, Duke of Edinburgh, went on display at Windsor Castle as part of a summer exhibition celebrating his life. The instrument, an R & J Beck microscope from the late 1800s, was given to the Duke to mark his term as RMS president in 1966 – the year in which he was also awarded Honorary Fellowship of the Society. The Prince's Presidency marked 100 years since the signing of the RMS Royal Charter. It was the first time the instrument had ever been seen on public display.

We are planning to make a much-desired return to in-person meetings in 2022, though we anticipate that both virtual and 'hybrid' events will continue to feature in our plans. The first RMS 'hybrid' event is set to go ahead on 5 – 6 January, with the UK Light Microscopy Facility Meeting 2022 taking place in York. For more details on all RMS events, please visit our Events Calendar at www.rms.org.uk

Finally, we would like to thank all our members, volunteers and partners from across the microscopy community for your ongoing support. We look forward to seeing you again in 2022. ■

Allison Winton, RMS Chief Executive

Nordic Microscopy Society (SCANDEM)

Apart from preparing for the EMC-2024 in Copenhagen (see separate report by Professor Klaus Qvortrup, conference chair), we organized our society's annual conference in June.

This was the 71st annual conference since SCANDEM was founded in 1948. The record has it that we have had such meetings every year, except only on two occasions. One of which is the meeting last year, the Covid year 2020. This was cancelled along with EMC-2020 in Copenhagen. Then early this year 2021, we began seeing recovery in our region, with good progress with the vaccination, but we were still far from being able to hold an in-person and on-site conference, hence, virtual meeting.

It was a one-day virtual conference on Thursday 17th June, 9 – 17 CEST or 7 – 15 GMT. As it was Norway's turn, this virtual meeting was organized from the University of Oslo, chaired by Professor Anette Gunnaes, our former SCANDEM president. The organization team celebrated the event as it was indeed the second time the society's annual conference was organized by Oslo – the first time was in 2003.

The meeting was a great success. Both life and material sciences were covered. About a hundred participants from the Nordic region as well as from other countries attended this virtual conference, with good representation of students and young researchers. Three plenary lectures were presented by Guillaume Jaquemet (FI), Knut-Endre Sjastad (NO) and Ilaria Testa (SE). A total of 33 invited talks from SCANDEM member countries were distributed among three parallel sessions and these included 12-SE, 11-NO, 4-DK, 4-IS and 2-FI. Impressively, ten companies presented their overview of products and development in the form of short talks. Several posters were also presented with short, pre-recorded videos. The conference concluded with SCANDEM General Assembly. ■

Kesara Anamthawat, SCANDEM 's president. Reykjavík, 15.12.2021

Société Française des Microscopies (SFMU) (SFμ)

In July 2021, French Society of Microscopy (Sfμ) held its 17th congress in Reims in a remote format. It was not what we hoped for, we all know the importance of face to face discussion and conviviality in such an event.

However, this congress was a success. It was divided into 12 symposia (4 Materials Sciences, 4 Life Sciences and 4 Common Symposia) and received more than 100 contributions.

The congress opened with the talk of Dr Gérard Liger-Belair for the plenary conference "Journey to the heart of a glass of champagne", which was a real discovery of all the various stages in the life of a bubble of champagne, from its birth on the surface of the glass to its bursting on the surface.

All of these observations were made with super fast cameras. Enough to start the conference in good spirits !

Despite the distance, it was pleasant to meet in the "wonder rooms" and chat around the e-posters.

The Raimond Castaing prize (dedicated to advanced researchers) for the category life science was awarded to Dr. Graça Raposo from Curie Institute where she is responsible for the team "Membrane structures and compartments". Throughout her career, Graça has been interested in the biogenesis, secretion, fate and function of endosomal organelles, two of which in particular, exosomes and melanosomes.

The prize for the category material sciences was awarded to Pr François Vurpillot from the University of Rouen, in the "Groupe de Physique des Matériaux", where he works on scientific instrumentation, surface physics and simulations, for the development of Atom Probe Tomography.

Dr Gérard LIGER-BELAIR (Team GSMA), plenary conference "Journey to the heart of a glass of champagne"

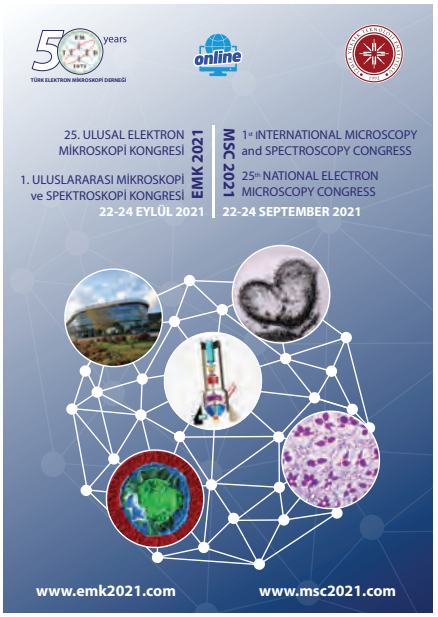
The Pierre Favard prize (dedicated to the best PhD work) was awarded to Margaux Schmeltz (Ecole polytechnique) for the category Life Science and Clément Lafond (MATEIS-University of Lyon 1) for the category Physics/Material Sciences.

Finally, we recall that, among its various activities focused on the training of young researchers and support for scientific events involving microscopy, the Sfμ finances many types of travel grants to attend national and international congresses.

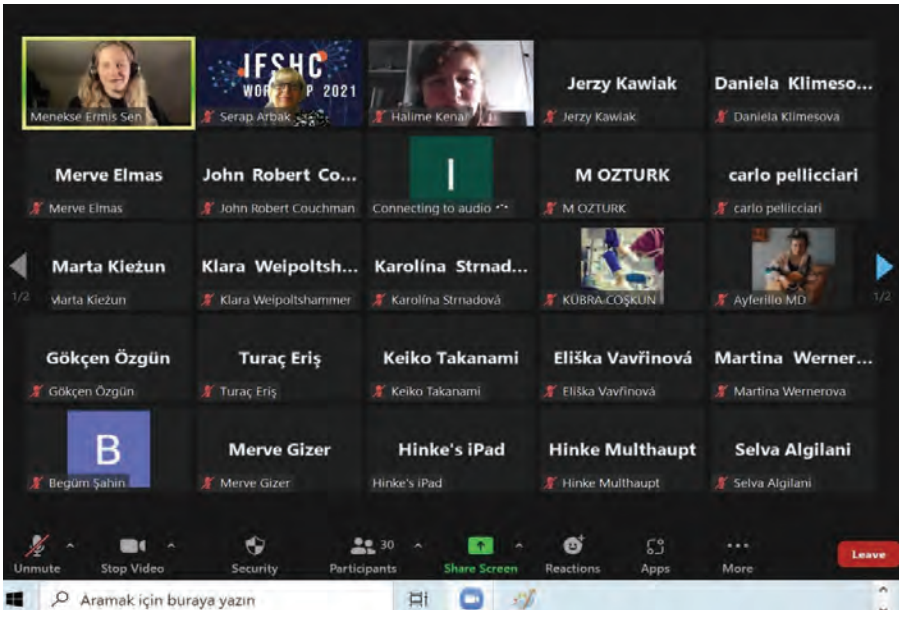
In addition, for two years, the Sfμ has been very happy to offer laboratory research internship grants to master's students in the field of microscopy. ■

Turkish Society for Electron Microscopy (TEMD)

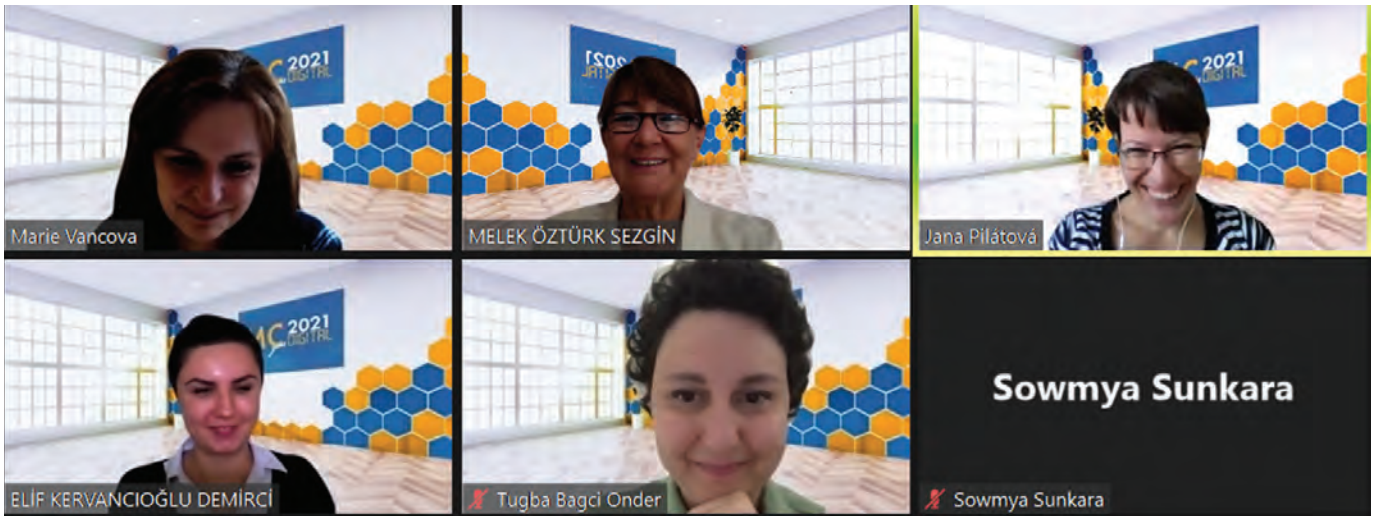
25th National Electron Microscopy Congress (EMK2021) and 1st International Microscopy and Spectroscopy Congress (MSC2021) have been organized as virtual congresses on September 22-24, 2021, under the auspices of the Turkish Society for Electron Microscopy (TEMD) by İzmir Institute of Technology. This year marks the 50th anniversary of the TEMD, and our national microscopy congress was held online for the first time due to the pandemic worldwide. Assoc. Prof. Aziz Genç (Izmir Institute of Technology) was the chair, and Prof. Servet Turan (Eskişehir Technical University) was the co-chair of the congresses. This three-day virtual event enabled participants to hear from worldwide on the wide variety of microscopy-related research and technical developments in the fields of life sciences and materials sciences. In addition, TEMD provided 50 participation scholarships to the young researchers for the congress.



The 2014 Nobel Prize in Chemistry Laureate Prof. Stefan W. Hell gave the opening plenary speech about the MINFLUX nanoscopy and related matters. Three more plenary sessions comprise keynote lectures given by Prof. Toyoshi Fujimoto (Japan), Prof. Quentin Ramasse (UK) and Prof. Jordi Arbiol (Catalonia, Spain). The subjects of the congresses were divided into 29 sessions between life sciences, materials sciences, and instrumentation. Forty-three internationally renowned scientists had been invited to present their state-of-the-art research. The scientific program also included 53 contributed oral presentations and 20 poster presentations, which our Scientific Committee reviewed. A total of 312 participants were registered to the online conference system. A Book of abstracts can be found on the conference website **www.msc2021.com**.



Prof. Dr. Türkan Erbengi Research Rewards, dedicated to the microscopy-related research conducted in Turkey, was given during the life sciences and materials sciences congress. Dr. Serçin Karahüseyinoğlu received the first prize in the life sciences category. Their study entitled "Three-dimensional neuron–astrocyte construction on matrigel enhances establishment of functional voltage-gated sodium channels." Dr. Umut Savacı received the first prize in the materials sciences category with their study entitled "Plasmon-enhanced photocatalytic and antibacterial activity of gold nanoparticles-decorated hematite nanostructures." Recipients of Prof. Dr. Türkan Erbengi Research awards presented their research to



the society members as part of the TEMD scientific seminar series. In this series, throughout the year, every third Thursday evening of each month, we have organized joint webinars given by the experts in life sciences and material sciences to bring all members of the society together and exchange ideas. We have also organized a joint webinar with the Turkish Society for Histology and Embryology.

TEMD has organized a session chaired by Prof. Serap Arbak in **the International Federation of Societies for Histochemistry and Cytochemistry (IFSHC) Online Workshop** on September 6-9, 2021. Prof. Halime Kenar and Assist. Prof. Menekşe Ermiş Sen has contributed to the session by their talks about microscopy of biomaterials.

TEMD was one of the Organizing Societies of **Microscopy Congress 2021 Vienna**. Prof. Servet Turan and Prof. Serap Arbak represented the Turkish Society as members of the Organizing Committee of MC21. Furthermore, two of our board members (Prof. Dr. Melek Öztürk Sezgin and Assoc. Prof. Dr. Meltem Sezen) chaired two different sessions, and several TEMD members gave invited or contributed talks. In addition, TEMD scholarships to cover the registration fee has been awarded to young members of the society.

Nanofabrication and Nano characterization Center for Scientific and Technological Advanced Research, Koç University, Istanbul.

A new microscopy laboratory was founded during 2020-2021 at Koç University. This state-of-the-art microscopy laboratory holds a Hitachi™ HF5000 Cs-corrected cold-FEG High-Resolution Scanning Transmission Electron Microscope installed at n2STAR- Nanofabrication and Nano characterization Center for Scientific and Technological Advanced Research, Koç University in 2021. In addition, it has analytical capabilities with Oxford Instruments and Gatan attachments. This laboratory's equipment also includes a Hitachi™ HT7800 Scanning Transmission Electron Microscope and a Hitachi™ NX5000 High-Performance Triple Beam FIB System. ■

Outstanding Paper Awards for 2020

2020 European Microscopy Outstanding Paper Awards

The winners of the European Microscopy Outstanding Paper Awards for papers published in 2020 are:

Instrumentation and Technique Development

Dora Mahecic, Davide Gambarotto, Kyle M Douglass, Denis Fortun, Niccoló Banterle, Khalid A Ibrahim, Maeva Le Guennec, Pierre Gönczy, Virginie Hamel, Paul Guichard and Suliana Manley: Homogeneous multifocal excitation for high-throughput super-resolution imaging, *Nature Methods* 17 (2020) 726-733.

Materials Sciences

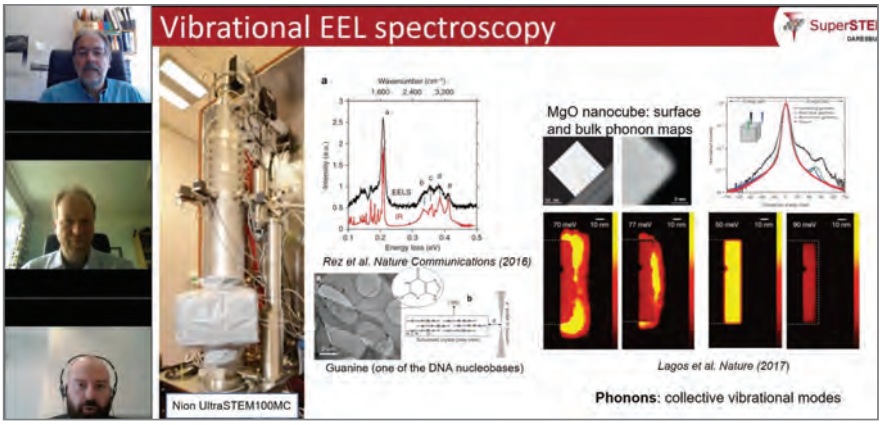
Mathias Uller Rothmann, Judy S. Kim, Juliane Borchert, Kilian B. Lohmann, Colum M. O'Leary, Alex A. Sheader, Laura Clark, Henry J. Snaith, Michael B. Johnston, Peter D. Nellist and Laura M. Herz: Atomic-scale microstructure of metal halide perovskite, *Science* 370 (2020) 548.

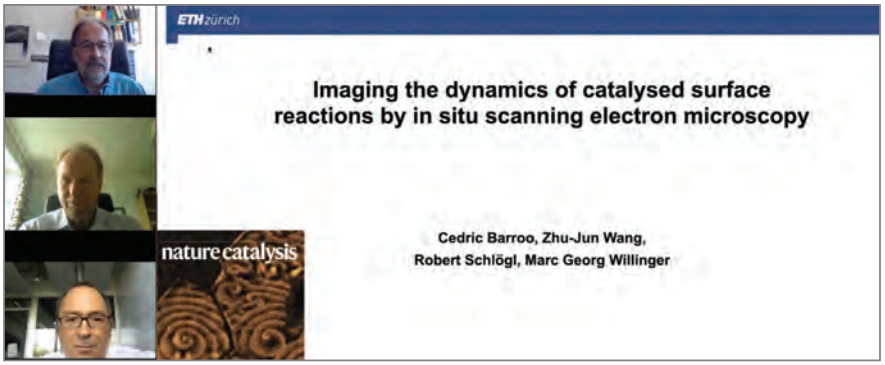
Life Sciences

Georg Wolff, Ronald W A L Limpens, Jessika C Zevenhoven-Dobbe, Ulrike Laugks, Shawn Zheng, Anja W M de Jong, Roman I Koning, David A Agard, Kay Grünewald, Abraham J Koster, Eric J Snijder and Montserrat Bárcena: A molecular pore spans the double membrane of the coronavirus replication organelle, *Science* 369 (2020) 1395-1398.

The first authors of these papers have received a mention of their award during the virtual General Assembly meeting at the EMS extension: **"The Joint Meeting of Dreiländertagung & Multinational Congress on Microscopy (MC 2021)"**, on August 24, 2021.

EMS extends its warmest congratulations to all winners. ■





Screen shots taken during the virtual EMS general assembly, August 2020

OPA 2021 jury members (judging on papers in 2020)

- Miran Ceh (Jožef Stefan Institute, Ljubljana, Slovenia)
- Juergen Plitzko (Max Planck Institute of Biochemistry, Martinsried, Germany)
- Florian Schur (IST Austria, Klosterneuburg, Austria)
- Iva Tolic (Ruđer Bošković Institute, Zagreb, Croatia)
- Maria Varela (Oak Ridge National Laboratory & University Complutense of Madrid, Madrid, Spain)
- Chair: Randi Holmestad (NTNU, Trondheim, Norway)

EMS presents its deepest thanks to this outstanding jury.

Reports of the 2020 EMS OPA Winners

Category : Instrumentation and Technique Development

Super-resolution microscopies have become an established tool in biological research. However, imaging throughput remains a main bottleneck in acquiring large datasets required for quantitative biology. Here we describe multifocal flat illumination for field-independent imaging (mfFIFI). By integrating mfFIFI into an instant structured illumination microscope (iSIM), we extend the field of view (FOV) to >100 × 100 μm^2 while maintaining high-speed, multicolor, volumetric imaging at double the diffraction-limited resolution. We further extend the effective FOV by stitching adjacent images for fast live-cell super-resolution imaging of dozens of cells. Finally, we combine our flat-fielded iSIM with ultrastructure expansion microscopy to collect three-dimensional (3D) images of hundreds of centrioles in human cells, or thousands of purified Chlamydomonas reinhardtii centrioles, per hour at an effective resolution of ~35 nm. Classification and particle averaging of these large datasets enables 3D mapping of posttranslational modifications of centriolar microtubules, revealing differences in their coverage and positioning. ■

Dora Mahecic

Category : Materials Sciences

Hybrid organic-inorganic perovskites have high potential as materials for solar energy applications, but their microscopic properties are still not well understood. Atomic-resolution scanning transmission electron microscopy has provided invaluable insights for many crystalline solar cell materials, and we used this method to successfully image formamidinium lead triiodide [$CH(NH_2)_2PbI_3$] thin films with a low dose of electron irradiation. Such images reveal a highly ordered atomic arrangement of sharp grain boundaries and coherent perovskite/PbI_2 interfaces, with a striking absence of long-range disorder in the crystal. We found that beam-induced degradation of the perovskite leads to an initial loss of formamidinium [$CH(NH_2)_2^+$] ions, leaving behind a partially unoccupied perovskite lattice, which explains the unusual regenerative properties of these materials. We further observed aligned point defects and climb-dissociated dislocations. Our findings thus provide an atomic-level understanding of technologically important lead halide perovskites. ■

Mathias Uller Rothmann

Category : Life Sciences

Coronaviruses transform membranes of the infected cell into double-membrane vesicles (DMVs) that are associated with viral RNA synthesis.

These replication organelles probably provide an optimized micro-environment for replication and a hiding place for viral replication intermediates from innate immune sensors. However, as these compartments appeared to be completely sealed, it remained unknown how the newly made viral RNA would be exported to the cytosol for translation and packaging into new virions.

In this study, Wolff *et al.* used cellular electron cryo-tomography to analyse the coronavirus replication organelles in close to native conditions, using murine coronavirus as a biosafe model. They discovered that DMVs contain multiple copies of a hitherto unique viral molecular pore. This protein complex spans the two DMV membranes and contains a central channel that would allow for RNA export to the cytosol. Subtomogram averaging and the use of an engineered virus expressing a GFP-tagged viral transmembrane protein also allowed the identification of the core component of the molecular pore. Six copies of the largest coronavirus transmembrane protein (nsp3), likely together with other viral and/or host proteins, are involved in the formation of this roughly 3-MDa large complex. Due to its putative key role in the coronavirus replication cycle, this molecular pore offers a new drug target to be explored in the quest for much needed strategies against coronaviruses. ■

Georg Wolff

EMS Calendar 2022

Winterschool 2022 - Practical course in advanced microscopy	17 to 21 January 2022	Zurich - Switzerland	SE
Virtual Microscopy Characterisation of Organic-Inorganic Interfaces 2022	01 and 02 March 2022	Virtual	
The 11th Annual World Congress of Nano Science & Technology	10 to 12 March 2022	Barcelona - Spain	
The Second Joint Meeting of the Microscopy Society of Ireland and the Scottish Microscopy Society	06 to 08 April 2022		SE
PLANT-MICROBE MICROSCOPY WORKSHOP	25 to 29 April 2022	Tulin - Austria	SE
ADVANCED WORKSHOP ON CRYO-ELECTRON TOMOGRAPHY	07 to 13 May 2022	Biocenter - Vienna - Austria	
EMAS 2022 Workshop	07 to 11 May 2022	Auditorium Maximum of the Jagiellonian University, Krakow, Poland - Krakow - Poland	SE
QEM2022	08 to 20 May 2022	School of TEM - Port Barcares - France	SE
PICO 2022	08 to 12 May 2022	Kateel Vaalsbroek - Vaalsbroek - Netherlands	EXTENSION
ISM2022 - The 55th Annual Meeting of the Israel Society for Microscopy	16 and 17 May 2022	Haifa - Israel	
Symposium : Advanced Nanoscale Characterization of Materials and Processes	06 to 10 June 2022	Sevilla - Spain	
Challenges in biological cryo electron microscopy: Faraday Discussion	13 to 15 July 2022	Sheffield - United Kingdom	
flowcytometryUK 2022	20 to 22 July 2022	Birmingham - United Kingdom	
16th Multinational Congress on Microscopy (MCM)	04 to 09 September 2022	Best Western Premier Hotel International Brno - Brno - Czech Republic	EXTENSION
LEEM PEEM 12	26 September 2022	Cordoba - Spain	

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email: sec@eurmicsoc.org , Fax: +33 (0)5 62 25 79 99

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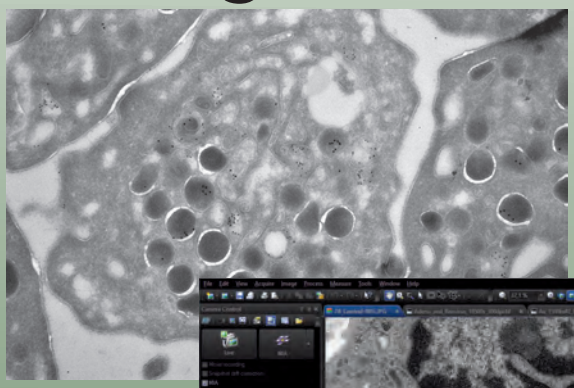

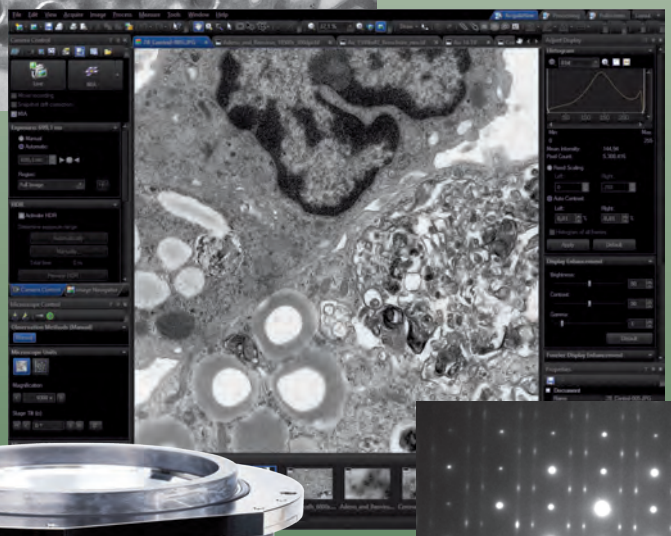

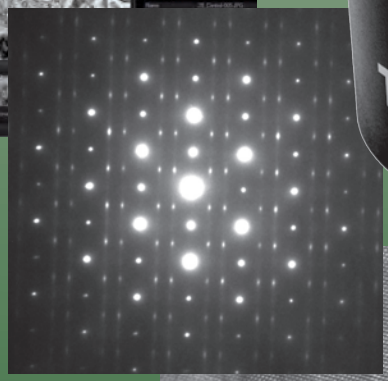

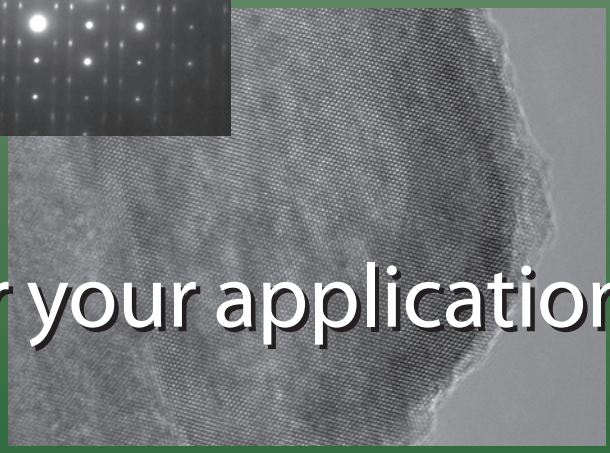

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