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# MCM2019

PROCEEDINGS

from the

## **14<sup>th</sup> MULTINATIONAL CONGRESS ON MICROSCOPY**

September 15–20, 2019, Belgrade, Serbia

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SEPTEMBER 15–20, 2019, BELGRADE, SERBIA

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We are honored to host for the first time the Multinational Congress of Microscopy (MCM2019) in Serbia. The aim of MCM conferences is to become a worldwide forum for discussion on different application of various microscopical techniques for both experts and young researchers. MCM conferences have always been a good instrument for establishment of new liaisons between laboratories interested in similar projects. Trade exhibitions also helped to gain insight into the newest development of microscopy

MCM2019 is jointly organized by 8 societies: Austrian Society for Electron Microscopy (ASEM), Croatian Microscopy Society (CMS), Czechoslovak Microscopy Society (CSMS), Hungarian Society for Microscopy (HSM), Italian Society of Microscopical Sciences (SISM), Serbian Society for Microscopy (SSM), Slovenian Society for Microscopy (SDM) and Turkish Society for Electron Microscopy (TEMED)

### **The bit of history**

Extracted from the "Opening lecture" given at the 10th Multinational Congress on Microscopy (Urbino, 4-7 September 2011) by Giuseppe Arancia,, Department of Technology and Health, Italian National Institute of Health Past President and Honorary Member of the Italian Society of Microscopical Sciences.

"In 1990, some representatives of the Italian, Hungarian, Austrian, Yugoslavian and Czechoslovak Societies for Electron Microscopy began to have contacts in order to evaluate the possibility of organizing jointly a multinational congress on electron microscopy. The inspirer reasons of this idea were, mainly, the substitution of a number of small congresses in neighboring countries with a single multinational meeting with the aim of increasing the scientific level and reducing the organizing costs, and to favor interactions and exchange of information and experiences among researchers operating in different countries."

Conference chairs

Dragan Rajnovć

Nataša Nestorović

Jasmina Grbović Novaković

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## SESSIONS AND CHAIRS

### INSTRUMENTATION AND TECHNIQUES

#### IT1 - Advances in sample preparation techniques

Evolution of the sample preparation methods and instrumentation runs parallel with the evolution of modern microscopy and image processing. Resolution and other capabilities of microscopes are solidly improving, setting new requirements for the preparation process. This session focuses on recent developments in sample preparation methods ranging from Focused Ion Beam (FIB) to ultramicrotomy, including various applications in different disciplines of science and technology.

Chairs:

**György Zoltán Radnóczy**, Centre for Energy Research, Hungarian Academy of Sciences, Budapest Hungary  
**Meltem Sezen**, Nanotechnology Research and Application Center, Sabanci University, Turkey

#### IT2 - 3D imaging, image processing, and phase-related techniques

Light, electron and x-ray techniques will be included in this session for all cases of using serial sectioning, or/and phase rather than amplitude imaging, or/and computational methods for data acquisition, analysis and 3-D visualization. Contributions are welcome in any area of holography, diffraction imaging, tomography, nano-CT and micro-CT, confocal microscopies (multiphoton and electron), differential phase contrast imaging, structured illumination, and exit-wave reconstruction for the case of biological as well as non-biological samples. This section/symposium is anticipated also as a forum to discuss computational methods for processing large complex datasets in all kinds of microscopies and spectroscopies with the aim of improving spatial and temporal resolution, as well as precision and contrast for visualization of various types structural information.

Chairs:

**Ognjen Milat**, Institute of Physics, Zagreb, Croatia  
**Thomas Heuser**, Vienna Bio Center, Vienna, Austria

#### IT3 - Diffraction techniques and spectroscopy

The session addresses methodology and implementation of electron diffraction and spectroscopy in characterization of various materials. Topics include contributions based on transmission and backscatter electron diffraction including diffraction tomography, and analytical techniques such as energy dispersive X-ray spectrometry, electron energy loss spectrometry, energy filtering, and cathodoluminescence. Contributions related to innovative/emerging techniques in electron diffraction and spectroscopies are highly encouraged.

Chairs:

**Mariana Klementova**, Institute of Physics CAS, Prague, Czech Republic  
**Miran Čeh**, Center for Electron Microscopy and Microanalysis, Jozef Stefan Institute, Ljubljana, Slovenia

#### **IT4 - Correlative, and super-resolution microscopy**

The session addresses new methodologies and advanced applications of correlative microscopies ranging from advanced light microscopy, electron microscopy and scanning probe microscopies. We will lay a particular focus on new developments in combining and correlating microscopy signals from the same specimen, which could open a new route to understand structure-property relations in biosciences and materials research. Contributions from all areas of microscopy including new data analysis methods are welcome.

Chairs:

**Ferdinand Hofer**, Institut für Elektronenmikroskopie und Nanoanalytik, TU Graz, Graz, Austria

**Kristof Kovacs**, Pannonia University, Veszprem, Hungary

#### **IT5 - In situ and environmental microscopy**

In situ electron microscopy has experienced a great rate of advancement in both techniques and instrumental capabilities over the last decade being a subject of increasing impact in life and materials sciences. The goal of the Symposium is to bring together an interdisciplinary group of scientists from materials science, chemistry, physics and the fields of biology, to highlight newly developed instrumental capabilities and experimental techniques for studying dynamic processes in functional materials and biological systems under realistic or near realistic conditions. The symposium is planned to cover, although is not restricted to, the following areas: in situ experiments spanning from nanoparticle nucleation and growth, studies of material transformations, catalysis, corrosion, and mechanical testing to aspects of correlative microscopy of biological processes; and in-operando experiments, such as batteries and other devices – all at high spatial- and time-domain resolution

Chairs:

**Sašo Šturm**, Department for Nanostructured Materials, Jozef Stefan Institute, Ljubljana, Slovenia

**Kónya Zoltán**, Dept. of Applied and Environmental Chemistry, University of Szeged, Szeged, Hungary

#### **IT6 - Advances in instrumentation and techniques (SEM, TEM, SPM, etc.)**

This session intends to cover recent advances in all fields of electron microscopy, but also including scanning probe related techniques. The focus is mainly on the instrumentation developments and related advances in methodology. The session includes aberration correction and other resolution/contrast improvements for TEM and SEM, low voltage EM techniques, analytical methods, as well as all exciting new ideas on electron and probe microscopy.

Chairs:

**Daniel Kiener**, Department Materialphysik, Universität Leoben, Leoben, Austria

**Vladislav Krzyzaneck**, Institute of Scientific Instruments CAS, Brno, Czech Republic

## **LIFE SCIENCES**

#### **LS1 - Live cell imaging, and intracellular dynamics**

Nowadays, a number of technologies make it possible to analyze biological processes directly in living organisms and cells, with the ultimate goal to localize and describe in vivo the dynamics of cell metabolic

pathways. Live cell imaging allows following cell populations, individual cells or specific molecules within complex living tissues and organs, while light and electron microscopy offer the possibility to assemble snapshots of events to obtain the dynamic pattern. This symposium will focus on the visualization and analysis of dynamic cell processes using various microscopy techniques, as well as on using experimental tools (e.g., optogenetics and novel probes) for monitoring cellular and tissue events

Chairs:

**Manuela Malatesta**, Verona University, Italy

**Pavel Hozak**, Institute of Molecular Genetics CAS, Prague, Czech Republic

## **LS2 - Structure and imaging of biomolecules**

Imaging of cellular and subcellular structures at the microscopic level is essential for the understanding important biological processes. Advanced microscopy techniques such as conventional confocal, lightsheet, multiphoton and super-resolution (STED) microscopes allow visualization of the dynamic processes on a time-based manner. The use of fluorescence is advantageous in labeling the multiple structures and thus permits visualization of the interactions between cellular structures. Furthermore, the structure of individual biomolecules can be addressed by cryo-electron microscopy (cryo-EM) techniques. In this session, the advantages and disadvantages of using advanced microscopy techniques for detecting biomolecules and determining their structure will be discussed.

Chairs

**Sevinc Inan**, Dep. of Histology and Embryology, Izmir University of Economics, Izmir, Turkey

**Tea Pavkov-Keller**, Institute of Molecular Biosciences (IMB), University of Graz, Graz, Austria

## **LS3 - Microscopic applications in symbiotic interactions, plants, microorganisms, and environmental sciences**

Microscopic techniques have wide application in biological and environmental sciences. Light microscopy has recently experienced an incredible increase in technology and methods development, enabling use in study cellular features and architectures, molecular movement and protein localization, as well as morphology of microscopic specimens and samples. Electron microscopy techniques have revolutionized studies of cellular ultrastructures and organelles, with a special contribution of ESEM which is designed for imaging specimens in their natural state. Modern environmental studies utilize microscopy to study symbiotic interactions, biofilms, and anthropogenic interventions and their impacts on the environment. This session is aimed to present novel achievements in microscopic applications in botany, microbiology and environmental sciences.

Chairs:

**Hrvoje Fulgosi**, Division of Molecular Biology, Ruđer Bošković Institute, Zagreb, Croatia

**Sonja Duletić Laušević**, Faculty of Biology, University of Belgrade, Belgrade, Serbia

## **LS4 - Neuroscience and histopathology**

Neuroscience and neuroscientists are among the first beneficiaries of the amazing development of imaging techniques in both light and electron microscopy. Super-resolution techniques have reached <20 nm resolution, due to fast imaging systems we can follow intercellular processes in situ, and the number of



publications involving the use of the Nobel-prize awarded ultra-cryo electron microscopy is rapidly increasing. This session wants to offer a range of lectures including topics of histopathology, in which classical and state-of-the art microscopic techniques contributed to significant discoveries in the field of neuroscience.

Chairs:

**Agnes Kittel**, Institute of Experimental Medicine, Hungarian Academy of Sciences, Budapest, Hungary  
**Gerd Leitinger**, Gottfried Schatz Research Center, Medical University of Graz, Graz, Austria

### **LS5 - High-resolution microscopy in life sciences**

Fluorescent microscopy is a well-established method for the non-invasive measurements of cell structures and processes; however, its resolution is limited. Popularization of super-resolution imaging techniques, with superior resolution, has allowed us to probe in detail cell structures that were previously only in domain of electron microscopy. In the field of electron microscopy, advancements in detectors, image processing and reconstruction software make possible currently to study larger biological structures at near atomic-resolution, understand their molecular dynamics and functions. Nonetheless, different types of microscopies are complementary and together can lead to new biological insights. The focus of this session will be to present recent discoveries in cell/tissue structure and function using advanced microscopy techniques.

Chairs:

**Jernej Jorgačevski**, Medical Faculty, University of Ljubljana, Ljubljana, Slovenia  
**Marie Vancová**, Biology Centre CAS, České Budějovice, Czech Republic

### **LS6 - Nanomaterials in biology and medicine**

The use of nanobiotechnology in human health has been increased in recent years. Drug carrier nanoparticles with their wide range of uses and advantages are promising approaches for the treatment of many diseases. Engineered nanomaterials are made to be attracted only by diseased cells and not by normal cells. These materials allow early detection and treatment of many diseases. One of the most challenging tasks in the fields of microscopic sciences is to visualize and identify the complex interaction of nanomaterials with biological material and correlate them with specific cellular functions in physiology and pathology. The topics of the session are: carbon-based, metal-based nanomaterials and nanoparticles such as, chitosan, alginate, polymeric micelles, cellulose, liposomes, dendrimers, inorganic nanoparticles, nanocrystals, metallic nanoparticles, quantum dots, protein and polysaccharides. The evaluation of cell death in the nano-systems as disease therapy; nanotoxicology mechanisms evaluations; advantages of nanoparticles and their role in oxidative stress are important topics to be addressed in this session.

Chairs:

**Serap Arbak**, Dep. of Histology and Embriology, Acibadem Mehmet Ali Aydinlar University, Turkey  
**Stefania Meschini**, ISS, Roma, Italy

### **LS7 - Multidisciplinary approaches for medical and biological sciences**

In biological and medical research, multidisciplinary approaches have become of great importance and interest for the scientific community. This session is focused on multiple applications and translational research in this field. Oral and poster presentations from biotechnology, biomedicine, diagnostics, and relat-

ed multidisciplinary studies, are cordially invited. Researches obtained by using microscopical and imaging techniques, as well as technological innovations, are particularly welcome.

Chairs:

**Elisabetta Falcieri**, Urbino University, Italy

**Melek Ozturk**, Dep. of Medical Biology, Istanbul University, Istanbul, Turkey

### **LS8 - Emerging and miscellaneous topics in life sciences**

Microscopic methods are rapidly advancing, offering new technologies to address novel problems in biological and biomedical research. This panel is initially intended for emerging topics that may not match directly to other sessions. The session will remain open for late breaking submissions until the end of August 2019. However, the latter submissions will be assigned as poster presentations.

Chairs:

**Jana Nebesářová**, Biology Centre CAS, České Budějovice, Czech Republic

**Nela Puškaš**, School of Medicine, University of Belgrade, Belgrade, Serbia

## **MATERIAL SCIENCES**

### **MS1 - Metals, alloys and intermetallics**

Importance of metals, alloys and intermetallic in everyday life cannot be stressed enough and the research aimed at the discovery of new compounds as well tailoring of the existing ones is currently at the forefront of materials science. The only way of improving desiring properties, such as extreme strength accompanied with the low weight and endurance in the robust atmospheric conditions, superior electrical and thermal conductivity, self-healing properties and so on, is by full elucidation of the crystal structure of materials. And what better way of understanding the structure than through the use of electron microscopy? This session will address, but is not limited to, the following topics: phase transformations, high-entropy alloys, shape memory alloys, energy and gas storage alloys, advanced alloys for transportation industry, new alloying materials used in medicine, ultrafast cooled materials, new alloys for corrosive environment, materials for solar cells and LEDs, catalytic materials based on intermetallics, intermetallic matrix composites.

Chairs:

**Matjaž Godec**, Institute of Metals and Technology, University of Ljubljana, Ljubljana, Slovenia

**Željko Skoko**, Faculty of Science, University of Zagreb, Zagreb, Croatia

### **MS2 - Nanoscale, nanostructured, and carbon based materials**

With the advent of nanoscience and nanotechnology, various electron microscopy techniques became indispensable in structural and chemical characterization and local property measurements of materials for nanotechnology, such as nanoparticles, one-dimensional structures (nanowires, nanotubes, nanorods), layered structures and heterostructures. This symposium is focused on the application of electron microscop-

py techniques in determination of structure and chemical composition of materials for nanotechnology on nano and atomic scale.

Chairs:

**Andreja Gajović**, Division of Materials Physics, Ruđer Bošković Institute, Zagreb, Croatia

**Sanja Milošević Govedarović**, Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia

### **MS3 - Thin films, coatings, surfaces and interfaces**

Thin films, coatings, and interfaces such as optical thin films and coatings, energy production related coatings, biomedical and biological thin films, thermal and environmental barrier coatings, electrical and magnetic coatings, component coatings for automotive, aerospace and manufacturing applications play important role in our daily life. Regardless of the application field, all thin films and coatings have in common that their properties depend on chemical and phase composition, crystalline structure, texture, microstructure, interface properties, and surface related properties. The goal of this session is to provide information on the relationship between the listed factors, and functional properties and processing of thin films, coatings, and interfaces. Contributions from all fields where thin films, coatings, and interfaces play vital role are welcome. Besides interfaces in thin film and coating systems, interfaces between different phases and grains are also covered by the session.

Chairs:

**Aleksandar Miletić**, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Serbia

**Regina Ciancio**, IOM-CNR TASC, Trieste, Italy

### **MS4 - Ceramics, composites, cultural heritage materials, rocks and minerals**

The session covers microscopy of wide range of materials including ceramics, composites, cultural heritage materials, rocks and minerals. Learning materials' phenomena from macroscopic down to the atomic scale to reconstruct reaction sequences and phase transformations in rocks, or man made historical and modern functional materials, utilizing microscopy and spectroscopy methods. Papers covering discovery of minerals and polytypes, phase transitions, exsolutions, topotaxial replacements and orientation relations studies, studies related to ceramic or composite textures, interfaces and grain growth phenomena, and finally, contributions investigating cultural heritage materials and preservation treatments are cordially invited. The session also invites discussion of sample preparation, as one of the crucial steps for microscopy observations

Chairs:

**Aleksander Rečnik**, Department for Nanostructured Materials, Jozef Stefan Institute, Ljubljana, Slovenia

**Snežana Vučetić**, Faculty of Technology, University of Novi Sad, Novi Sad, Serbia

### **MS5 - Polymers, biomaterials, and soft materials**

The session invites contributions concerning current research on both fundamental and applied aspects of polymers, biomaterials and soft materials. It will address, but is not limited, to the topics of: molecules on surfaces (including films and supramolecular architectures); physical/chemical properties of polymeric films, surfaces and interfaces; polymeric matrix; polymeric/molecular nanostructured systems; colloidal systems (such as polymer self-assembled systems, micelles, beads and foams). Molecular systems

should be investigated by state-of-the-art microscopy techniques (TEM, SEM, SPM, LM). Technological applications of such materials in organic electronic devices, organic sensors and active surfaces, for instance, are encouraged.

Chairs:

**Cristiano Albonetti**, CNR, Bologna, Italy

**Suzana Šegota**, Ruđer Bošković Institute, Zagreb, Croatia

### **MS6 - Semiconductors, devices, and magnetic materials**

Even after several decades of theoretical and applied research, Semiconductors, Electronic devices and Magnetic materials are still an important field of study. This is due to both the variety of industrial application as well as the theoretical opportunities offered by such materials in understanding the structure of matter. Moreover, the continuous scaling down of the size of structures and devices requires updated instrumentation and skills able to investigate samples at the nanometric or atomic level. This session welcomes contributions on morphological, structural and analytical characterization of semiconductor and magnetic materials and devices. This includes (but it is not limited to) classic semiconductors, wide-gap materials, heterostructures, dielectrics and materials for interconnects, magnetic materials as well as their applications, as in devices for micro- and nano-electronics. All contribution should emphasize the role of microscopy in the characterization of the materials

Chairs:

**János Lábár**, Center for Energy Research, Hungarian Academy of Sciences, Budapest, Hungary

**Roberto Balboni**, CNR, Bologna, Italy

### **MS7 - Materials for energy harvesting, production, storage, and catalysis**

Advanced energy related materials and catalytic ones encounter worldwide a growing demand. This session demonstrates that cutting edge microscopy methods are necessary to comprehend their properties and tailor the materials for sustainable future.

Chairs:

**Peter Karthaler**, Faculty of Physics, University of Vienna, Vienna, Austria

**Sandra Kurko**, Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia

### **MS8 - Emerging and miscellaneous topics in material sciences**

The session covers different topic in materials science. The session includes new developments, new strategies and interdisciplinary topics. The talks will be focused on hierarchy materials, self-healing materials, biomaterials, self-reporting materials and other emerging and miscellaneous topics in material sciences.

Chairs:

**Alena Michalcova**, The Department of Metals and Corrosion Engineering, University of Chemistry and Technology in Prague, Prague, Czech Republic

**Servet Turan**, Eskisehir Technical University, Eskisehir, Turkey

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## Scanning electron microscopy-a sensitive tool in Porifera determination

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Freshwater sponges belong to macrozoobenthic organisms with a worldwide distribution. European rivers and lakes, most generally, have been well analyzed for the presence of Porifera [1]-[5]. Some geographical areas, however, remain largely unexplored. Among these are West Balkan countries. The aim of the present study was to determine sponge species collected in Macedonia and Serbia based on the specific morphology of their mineral skeleton, using light and scanning electron microscopy (SEM). In total 122 specimens were collected and spicules were prepared by nitric acid technique [6]. Determination was mainly performed by observing sponge structures under light microscope. For fine analysis of sponge skeleton elements, in some cases, SEM was applied allowing measurements of these elements to be done for an accurate species determination (Figure 1.).

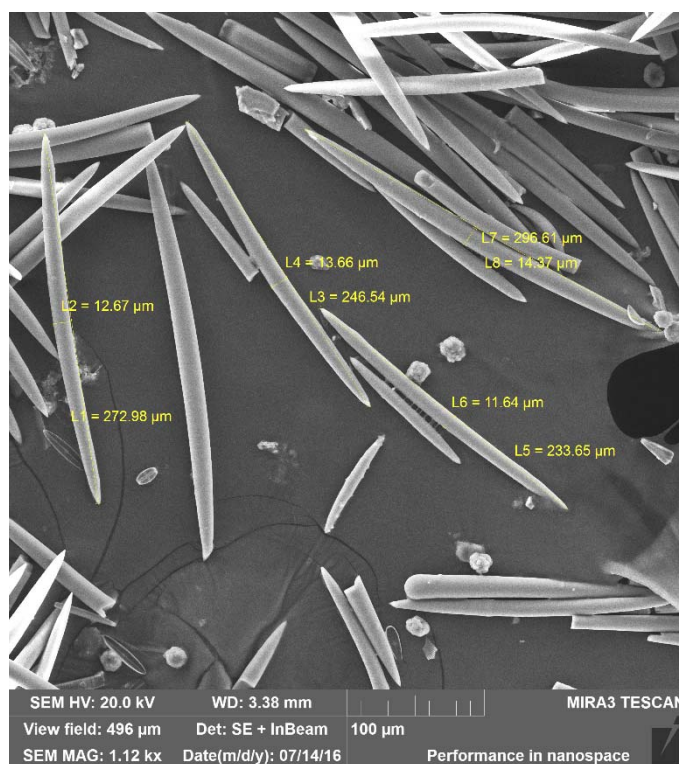


Figure 1. SEM image of spicules (megascleres) of *E. fragilis* with measured lengths and widths

As revealed by the length and width of sponge spicules, as well as their shape, among the collected specimens the following species have been identified: in Serbia- *Spongilla lacustris* Linnaeus, 1758, *Eunapius fragilis* (Leidy, 1851), *Ephydatia fluviatilis* (Linnaeus, 1759), *Ephydatia muelleri* (Lieberkühn, 1856), and *Trochospongilla horrida* Weltner, 1893; in Macedonia *S. lacustris*, *E. fluviatilis*, *S. stankovici* Arndt 1937, *Spongilla carteri* Bowerbank, 1863 and *Ochridaspongia rotunda* (Arndt 1937). In conclusion, SEM made possible an efficient assessment of fine sponge skeletal structure needed for species identification.

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