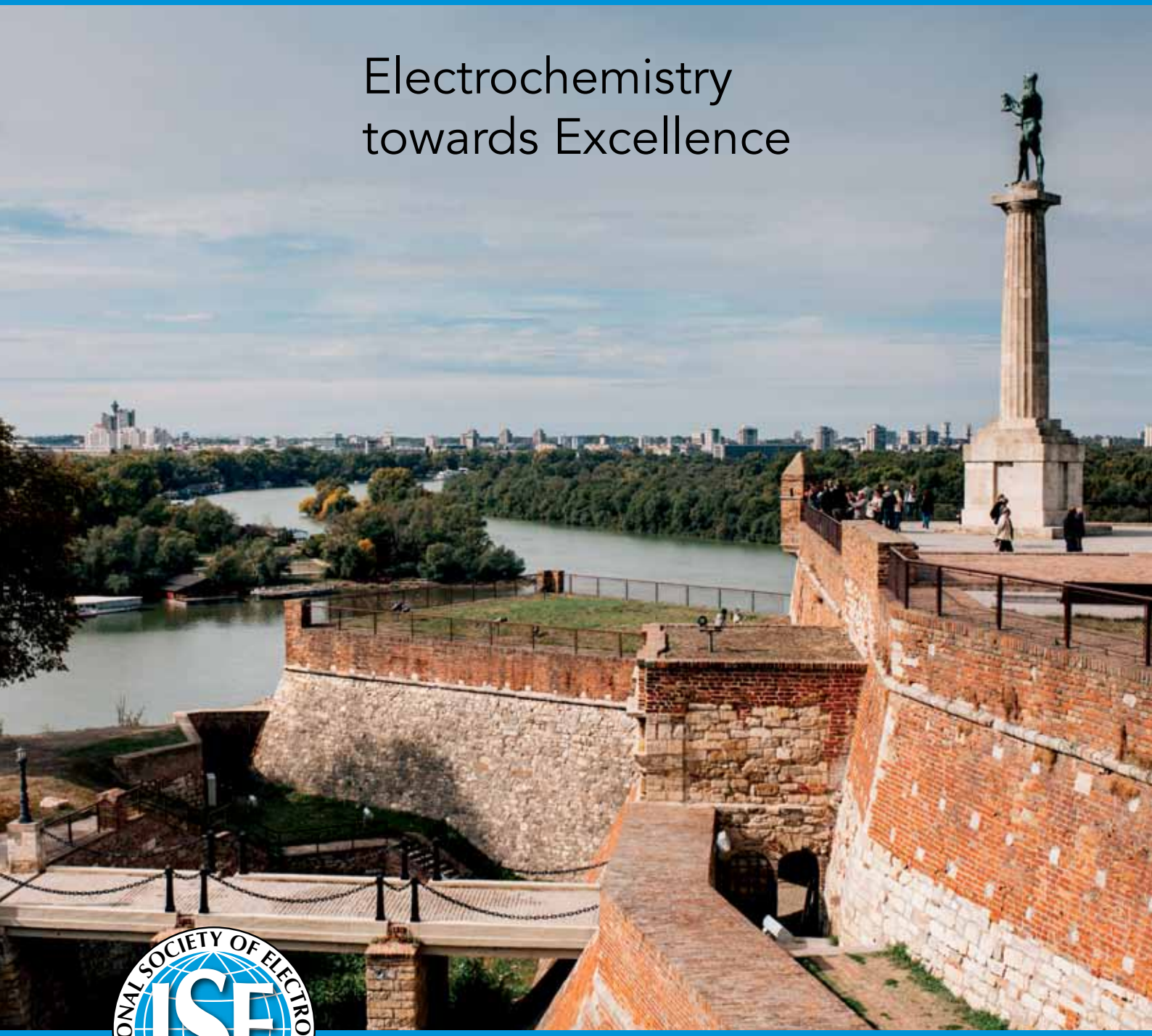
71st Annual Meeting

of the International Society of Electrochemistry

30 August - 4 September 2020
Belgrade, Serbia



Electrochemistry
towards Excellence

https://annual71.ise-online.org
e-mail: events@ise-online.org

Organizing Committee

Plamen Atanassov, *Albuquerque, NM, USA*
Jelena Bajat, *Belgrade, Serbia (co-chair)*
Aleksandar Bojić, *Niš, Serbia*
Stanko Brankovic, *Houston, TX, USA*
Aleksandar Dekanski, *Belgrade, Serbia (co-chair)*
Nevenka Elezović, *Belgrade, Serbia*
Marilia Goulart, *Maceio, Brazil*
Gyöngyi Vastag, *Novi Sad, Serbia*
Zhong-Qun Tian, *Xiamen, China*
Gunther Wittstock, *Oldenburg, Germany*

Invitation to ISE 2020

You are warmly invited to the **71st Annual ISE Meeting** to be held in Belgrade, Serbia from **30st August to 4st September 2020**. The meeting will take place at the Sava Conference Center.

Belgrade is an important conference, cultural and business centre in the region. It is centrally located in Europe and presents the hub of all regional activities, as well as scientific ones. The University of Belgrade has a long-standing tradition of electrochemistry. Due to a high level of education in this field the University has given significant scientific contributions to electrochemical science, associated to the "Belgrade electrochemistry school", founded by prominent electrochemists, professors Despić and Dražić. Their successors are important Serbian and world's scientists whose goals of achieving excellence and recognition are what the 71st ISE Meeting is striving to accomplish through its theme. The scientific program will consist of symposia supported by all ISE Divisions and will cover all topics significant to the electrochemical community.

We look forward to welcome you in Serbia to enjoy the excellent science in an inspiring environment.

Summary of Symposia

Symposium 1	Membrane-based electrodes: from traditional potentiometry to dynamic electrochemistry
Symposium 2	Nanomaterials in electroanalysis and nanoelectrochemical sensors
Symposium 3	Electrochemical conversion of CO_2: Sensing, monitoring, mechanism and technological development
Symposium 4	New trends in bioelectrochemistry
Symposium 5	Coupling electrochemical and optical methods to study chemo- and bioobjects: light as sensor and actuator
Symposium 6	Advances in microbial electrochemistry for energy conversion, biotransformation, bioremediation and electroanalysis
Symposium 7	Electrochemical capacitors: beyond double-layer storage
Symposium 8	Next generation batteries – S&T challenges and opportunities
Symposium 9	Fuel cells and electrolyzes: promising energy for the future
Symposium 10	Electrochemical and electroless deposition: tailoring growth from monolayers and nanostructures to functional applications
Symposium 11	Corrosion and corrosion protection strategies
Symposium 12	Electrochemical engineering for environmentally friendly processing and environmental protection
Symposium 13	Electrochemistry in the digital age: model-supported process analysis and design
Symposium 14	Future of molecular electrochemistry
Symposium 15	When molecular electrochemistry meets luminescence: from fundamentals to analytical applications
Symposium 16	Two-dimensional materials: An electrochemical perspective
Symposium 17	Electroactive materials: polymers, inorganic solids, nanocomposites and hybrid materials
Symposium 18	Nanoelectrochemistry and electrocatalysis – from fundamentals to applications
Symposium 19	Electrochemical surface and interface
Symposium 20	Cutting edge electrochemical measurement techniques
Symposium 21	Education and transmission of knowledge from the past to the new generations of electrochemists
Symposium 22	General Session

Symposium 1

Membrane-based electrodes: from traditional potentiometry to dynamic electrochemistry

Sponsored by :
Division 1, Analytical Electrochemistry
Division 3, Electrochemical Energy Conversion and Storage
Division 6, Molecular Electrochemistry

Membranes are used in many different applications in which electrochemistry techniques act as the analytical signal readout or to fully tune ion transfer processes across the membrane. This symposium aims to bring together current studies involving membrane-based electrodes and also the use of ion exchange membranes for miscellaneous purposes. *Thus, the scope of this symposium include (among others):*

- Ion selective electrodes: fundaments and analytical applications
- Novel concepts involving ion exchange membranes
- Tuned ion transfer processes (in terms of selective receptors and the readout)
- Theoretical modelling of the working mechanism of membrane-based electrodes
- The exploration of new materials in membrane-based electrodes
- Water remediation processes
- Proton exchange membranes fuel cells and electrolyzers
- Healthcare and other applications
- Nanopore electrochemistry
- Biomembrane electrochemistry
- Electroanalysis based on microdialysis

Symposium Organizers

Maria Cuartero Botia (Coordinator), *KTH Royal Institute of Technology, Sweden*
Gaston Crespo, *KTH Royal Institute of Technology, Sweden*
Maria Assunta Navarra, *Sapienza University of Rome, Italy*
Guobao Xu, *Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, China*
Valentin Mirčeski, *Ss. Cyril and Methodious University, North Macedonia*

Symposium 2

Nanomaterials in electroanalysis and nanoelectrochemical sensors

Sponsored by:
Division 1, Analytical Electrochemistry

This Symposium would like to be a focus on recent advances in the use of nanomaterials in electroanalytical chemistry, to understand if the game (i.e. the effort and commitment for their preparation) is worth the candle (i.e. their unique properties yielding unforeseen interesting analytical performances).
The manufacturing effort includes not only the synthetic and functionalization work, but also the increasing use of electrochemical simulation to enhance nanoelectrochemical sensor device design and architecture definition prior to fabrication, which enable more autonomous systems for sensing applications in different fields, such as health, environment protection and agriculture.
Moreover, recent advances on lab-on-a-chip devices, single-use sensors, paper-based electrodes, wearable or smartphone-based electrochemical systems and multiplexed or orthogonal analysis with integrated spectroscopic analysis, will be developed.
Finally, the use of electroanalytical techniques for investigating the properties of nano-objects will be considered, particularly focusing on the impact of these materials on human health and environmental safety.

Symposium Organizers

Luigi Falciola (Coordinator), *Università degli Studi di Milano, Italy*
Alain Walcarius, *Université de Lorraine, France*
James Rohan, *University College Cork, Ireland*
Sotirios Sotiropoulos, *Aristotle University of Thessaloniki, Greece*
Biljana Šljukić, *University of Belgrade, Serbia*
Aleksandar Radu, *Keele University, UK*

Symposium 3

Electrochemical conversion of CO_2: Sensing, monitoring, mechanism and technological development

Sponsored by: Division 1, Analytical Electrochemistry
Division 4, Electrochemical Materials Science
Division 5, Electrochemical Process Engineering and Technology

This symposium aims to embrace all relevant (fundamental and technological) aspects of CO_2 capture and conversion to value-added chemicals. This symposium is co-organized by three of the ISE Divisions (1, 4 and 5) and is devoted to explore all different approaches provided by the electrochemistry in order to detect, monitor and mitigate the CO_2 accumulation, with the possibility to synthesize valuable products.

Contributions are welcome in, but not limited to, the following areas:

- Sensing of airborne CO_2, monitoring during its transformation upon application of any electrochemical technology.
- CO_2 conversion by homogeneous or heterogeneous catalysts in different solvent media, including ionic liquids.
- Mechanism studies, including reaction products and intermediates detection and quantification by spectroscopic and spectrometric techniques.
- Sustainable advanced electrodes including metals, alloys, semiconductors, metal-organic frameworks (MOFs), carbon-based and electrochemically synthesized materials.
- Reactor design for CO_2 electrolysis systems
- Technological application of CO_2 conversion processes and economic analysis

Symposium Organizers

Carlos M. Sánchez-Sánchez (Coordinator), *Sorbonne Université, France*
Tom Breugelmans, *University of Antwerp, Belgium*
Ignacio Sirés Sadornil, *University of Barcelona, Spain*
Nejc Hodnik, *National Institute of Chemistry, Slovenia*

Symposium 4

New Trends in Bioelectrochemistry

Sponsored by:
Division 2, Bioelectrochemistry

The main symposium of division 2 will cover all aspects of bioelectrochemistry from basic investigations to different fields of application including photobioelectrochemistry. Studies of different biomolecules, biomimetica, cell compartments and whole cells will be described. New materials and material combinations will be covered as well as new developments in methodology and hyphenated techniques.

Topics, the symposium is focused on:

- Fundamental elucidation of electron / proton transfer pathways in biological systems
- Heterogeneous electron transfer at bioelectrodes
- Novel electrodes, materials and electrode arrays for biological systems
- Novel experimental and theoretical tools in bioelectrochemistry
- microelectrochemistry and study of biological systems
- Sensing of small molecules or biomolecules by means of biological recognition elements or modified electrodes including point-of-use sensing
- Energy conversion / storage including biofuel cells, photobioelectrodes, biobatteries, biocapacitors
- Electrosynthesis with biocatalyzed reactions and cascades and electrobiotechnology

Symposium Organizers

Fred Lisdat (Coordinator), *Technical University Wildau, Germany*
Nicolas Plumeré, *Ruhr University Bochum, Germany*
Julea Butt, *University of East Anglia in Norwich, UK*
Victor Constantin Diculescu, *National Institute of Materials Physics, Romania*

Symposium 5

Coupling electrochemical and optical methods to study chemo- and bioobjects: light as sensor and actuator

Sponsored by:
Division 2, Bioelectrochemistry
Division 7, Physical Electrochemistry

In a sustainable economy, bio-objects and chemically modified interfaces attract increasing interest for applications including energetics, synthesis and sensing. This symposium will focus on coupling spectroscopic methods with electrochemical potential control for the study of bio-objects, biomimetic systems and electrochemical reactions covering the size range from macroscopic to the single-molecule level. With the focus on methods, the symposium will also include functional systems intended to be used for triggering reactions or sensing applications. Further, it will comprise fundamental studies on the influence of light on (bio)chemical reactions. This highly interdisciplinary topic aims at bringing together experts in bioelectrochemistry, electroanalysis, in situ microscopies (SECM, STM, AFM, light microscopy) and spectroscopic methods, as well as signal processing, technique development and image processing.

Topics may include, but are not limited to, the following:

- rationalisation of behaviour at bioelectrodes
- light–matter interactions at (bio)electrochemical interfaces
- spectroelectrochemistry
- electrochemiluminescence
- plasmonic effects on mechanisms and reaction rate
- new developments in sensor technologies
- integration of bio- and bioinspired objects with semiconductor structures
- single-molecule switching and dynamics.

Symposium Organizers

Elisabeth Lojou (Coordinator), *CNRS, Aix Marseille University, France*
Kylie Vincent, *Oxford University, UK*
Stijn Mertens, *Lancaster University, UK*
Priscilla G L Baker, *University of the Western Cape, South Africa*

Symposium 6

Advances in Microbial Electrochemistry for Energy Conversion, Biotransformation, Bioremediation and Electroanalysis

Sponsored by:
Division 2, Bioelectrochemistry
Division 3, Electrochemical Energy Conversion and Storage-
Division 1, Analytical Electrochemistry
Division 4, Electrochemical Materials Science

This symposium covers key recent advances in electrochemical microbial research, from basic studies of microbial electrochemical systems to electrochemical technological applications including energy production, co-generation of chemicals and electricity and bioelectrosynthesis, recovery of environmental resources, wastewater treatment, food and agricultural analysis, and environmental monitoring. Electrochemical engineering contributing to improved bioelectrochemical cell/reactor designs and process control as applied to microbial electrochemical technology are also covered.

Topics the symposium focus on are:

- Fundamental studies of mechanisms of bacterial extracellular electron transfer reactions
- Bioengineering of bacteria to improve extracellular electron transfer
- New experimental and modeling strategies to address electrochemical processes in microbial electrochemical systems
- Environmental, food and agricultural electroanalysis with microbial systems
- Electrochemical detection of bacteria and biofilms
- Microbial energy conversion, production and storage devices, including microbial fuel cells, biosupercapacitors and batteries
- Microbial electrosynthesis and electrotransformation
- New electrodes materials and designs for microbial electrochemical systems

Symposium Organizers

Elena Ferapontova, (Coordinator), *Aarhus University, Denmark*
Lo Gorton, *Lund University, Sweden*
Carlo Santoro, *University of the West of England, UK*
Mathieu Etienne, *Université de Lorraine, France*
Eileen Hao Yu, *Newcastle University, UK*
Tanja Vidakovic-Koch, *Max Planck Institute for Dynamics of Complex Technical Systems, Germany*

Symposium 7

Electrochemical capacitors: beyond double-layer storage

Sponsored by:
Division 3, Electrochemical Energy Conversion and Storage

The symposium will cover several aspects of electrochemical capacitors development, starting from fundamental aspects concerning the double-layer storage, pseudocapacitive effects and redox-related phenomena at electrode/electrolyte interface in protic and aprotic media. In this term, reports on novel concepts and novel chemistries for high-power and high-energy systems, falling into the scope of capacitive storage, are of symposium interest. The broad scope of this symposium welcomes contributions reporting on the materials, electrolytes and separators in electrochemical capacitors application. Apart from typical electrochemical reports, results on the electrolyte formulation, electrode fabrication and modeling studies are welcome. Since the long-term performance is one of the crucial aspects in electrochemical capacitors development, contributions providing insights into ageing aspects are also expected. Special attention will be focused on the rapidly growing subject of operando techniques in electrochemical capacitors characterization, providing new insights for understanding of capacitive and faradaic charge storage mechanisms.

Symposium Organizers

Sonia Dsoke (Coordinator), *Helmholtz Institute Ulm & Institute for Applied Materials – Energy Storage Systems, Germany*
Krzysztof Fic, *Poznan University of Technology, Poland*
Wataru Sugimoto, *Shinshu University, Japan*
Zoran Mandić, *University of Zagreb, Croatia*
Branimir Grgur, *University of Belgrade, Serbia*

Symposium 8

Next Generation Batteries – S&T Challenges and Opportunities

Sponsored by:
Division 3, Electrochemical Energy Conversion and Storage

Almost 30 years after the commercialization of the first Li-ion battery, the number of applications has rapidly increased and it appears that this technology is presently the only one simultaneously ensuring performance, cost, and safety demands. However, these needs are steadily increasing, which requires continuous advancements towards the existing and the development of new cell components and processing techniques – ideally based on the fundamental understanding of, e.g., the reactions occurring in the bulk and at the interface of the active material particles. These efforts include also the replacement of potentially critical elements, such as cobalt or lithium itself.
Accordingly, this symposium is devoted to recent advances in elucidating fundamental electrochemical mechanisms and reactions occurring in Li-ion and post-Li-ion battery chemistries as well as the development of optimized and new cell components. Studies, which are related to other (applied) aspects of batteries, including also innovative characterization techniques, are welcome as well.

Symposium Organizers

Dominic Bresser (Coordinator), *Helmholtz Institute Ulm and Karlsruhe Institute of Technology, Germany*
Robert Kostecki, *Lawrence Berkeley National Laboratory, USA*
Miran Gaberšček, *National Institute of Chemistry, Slovenia*
Milica Vujković, *University of Belgrade, Serbia*

Symposium 9

Fuel Cells and Electrolysis: Promising energy for the future

Sponsored by:
Division 3, Electrochemical Energy Conversion and Storage

This symposium covers fundamental and applied studies in the design of novel electrochemical interfaces that improve the efficiency of fuel production in electrolyzers and their utilization in fuel cells.

Specific topics as follows:

- New functional materials and cell components (e.g., electrocatalysts, ionomers, electrolyte membranes/ separators, gas diffusion layers, bipolar plates, etc.) for both low- and high-temperature applications.
- Novel electrocatalysts for oxygen reduction, electro-oxidation of hydrogen and organic fuels, oxygen and hydrogen evolution.
- Electrolyte membrane/separators and ionomers for fuel cells, water electrolysis systems, and H_2O-CO2 co-electrolysis: synthesis and characterization of polymeric, ceramic, ionic liquid and nanocomposite systems.
- Improved understanding of electrochemical processes and new insights into the degradation of fuel cell and electrolyzer components in low- and high-temperature applications.
- Operando diagnostics and in situ characterization of fuel cells, water electrolysis systems, and H_2O-CO_2 co-electrolysis.
- Theoretical studies and computational modeling of functional materials and cell components.
- Novel materials for anion exchange membrane fuel cells, electrolyzers and H_2O-CO_2 co-electrolysis systems.
- Development of precious metal free catalysts and anion conductive membranes and ionomers. Understanding electrochemical reactions occurring under alkaline conditions

Symposium Organizers

Nenad Marković (Coordinator), *Argonne National Lab, USA*
Vojislav Stamenković, *Argonne National Lab, USA*
Hamish Andrew Miller, *CNR-ICCOM, Italy*
Milica Marčeta Kaninski, *University of Belgrade, Serbia*
Frano Barbir, *University of Split, Croatia*

Symposium 10

Electrochemical and electroless deposition: tailoring growth from monolayers and nanostructures to functional applications

Sponsored by:
Division 4, Electrochemical Materials Science

Various processes of electrochemical material growth are now available, capable to control composition, morphology, structure and thickness of a range of materials, from the monoatomic layer to the mm range. Surface methods utilize underpotential procedures, which could be utterly precise but are generally slow; in contrast, overpotential methods are faster but not as precise. This symposium aims to involve the "UPD community" and the "electroplaters" in a forum focused on bridging the gap between these two classes of materials. Contributions in the general areas of UPD, few atomic layers materials and thick films are welcome; however, we aim to concentrate the discussion on the gray area between the two, where novel concepts may be needed to enhance the quality of materials. *In particular, contributions are welcome, but not limited to:*

- Concepts and methods of few monolayer growth
- Two-dimensional materials
- Tailoring micro/nanostructure over length scales via voltage waveforms and/or additives
- Electrochemical synthesis in ionic liquid, novel media
- The origin of growth instability and methods to avoid them
- Electrodeposited alloys, compounds, oxide and chalcogenides
- Functional materials enabled by growth control

Symposium Organizers

Giovanni Zangari (Coordinator), *University of Virginia, USA*
Fu-Ming Wang, *National Taiwan University of Science and Technology, Korea*
Piotr Zabinski, *AGH University of Science and Technology, Krakow, Poland*
Nebojša Nikolić, *University of Belgrade, Serbia*

Symposium 11

Corrosion and corrosion protection strategies

Sponsored by:
Division 4, Electrochemical Materials Science

This symposium includes all aspects of corrosion science and technology with a special focus on growth and characterization of passive films, anodic oxides and smart coatings for corrosion protection of metallic materials. It will cover both theoretical analysis and experimental investigations, including the modelling of the interface and the description of new techniques for the study of corrosion and coatings degradation.

Topics include but are not limited to:

- Corrosion Mechanisms, Methods, Modelling and Monitoring
- Passive Films: formation, chemistry, structure and properties
- Growth and characterization of chemically and electrochemically formed protective coatings
- Tribocorrosion: fundamentals, materials and prevention
- Electrodeposition for Corrosion and Wear Protection.
- In situ and ex situ characterization of surfaces and relationship between their structure and corrosion resistance
- Advanced electrochemical and analytical tools for assessing corrosion resistance and passive films.
- Passivity and corrosion of Steel in Concrete
- Corrosion studies for safeguard of Archaeological and Historical Artefacts
- Corrosion and corrosion protection of Biomaterials

Symposium Organizers

Vincent Vivier (Coordinator), *Sorbonne University – Paris, France*
Michele Curioni, *University of Manchester, UK*
Emma Angelini, *Politecnico di Torino, Italy*
Monica Santamaria, *Università degli Studi di Palermo, Italy*
Liana Muresan, *Babeş-Bolyai University, Cluj-Napoca, Romania*
Ingrid Milošev, *Institut Jožef Stefan, Slovenia*

Symposium 12

Electrochemical Engineering for Environmentally Friendly Processing and Environmental Protection

Sponsored by:
Division 5, Electrochemical Process Engineering and Technology

Electrochemical engineering provides a platform for the introduction of green chemistry and sustainable processes for the chemical and biological industry. Sustainability of resources such as reduction in air emissions, energy consumption, and water consumption are key for sustainable manufacturing of chemicals and materials. Besides preventing new emissions to the environment, electrochemical technologies are also effective in existing pollutions abatement. This symposium will provide an international forum for the presentation and discussion of the most recent developments on the application of electrolysis and electrochemical processes in traditional chemical processes that had enabled and/or could lead to sustainable manufacturing and green chemistry.

Topics of interest include, but are not limited to:

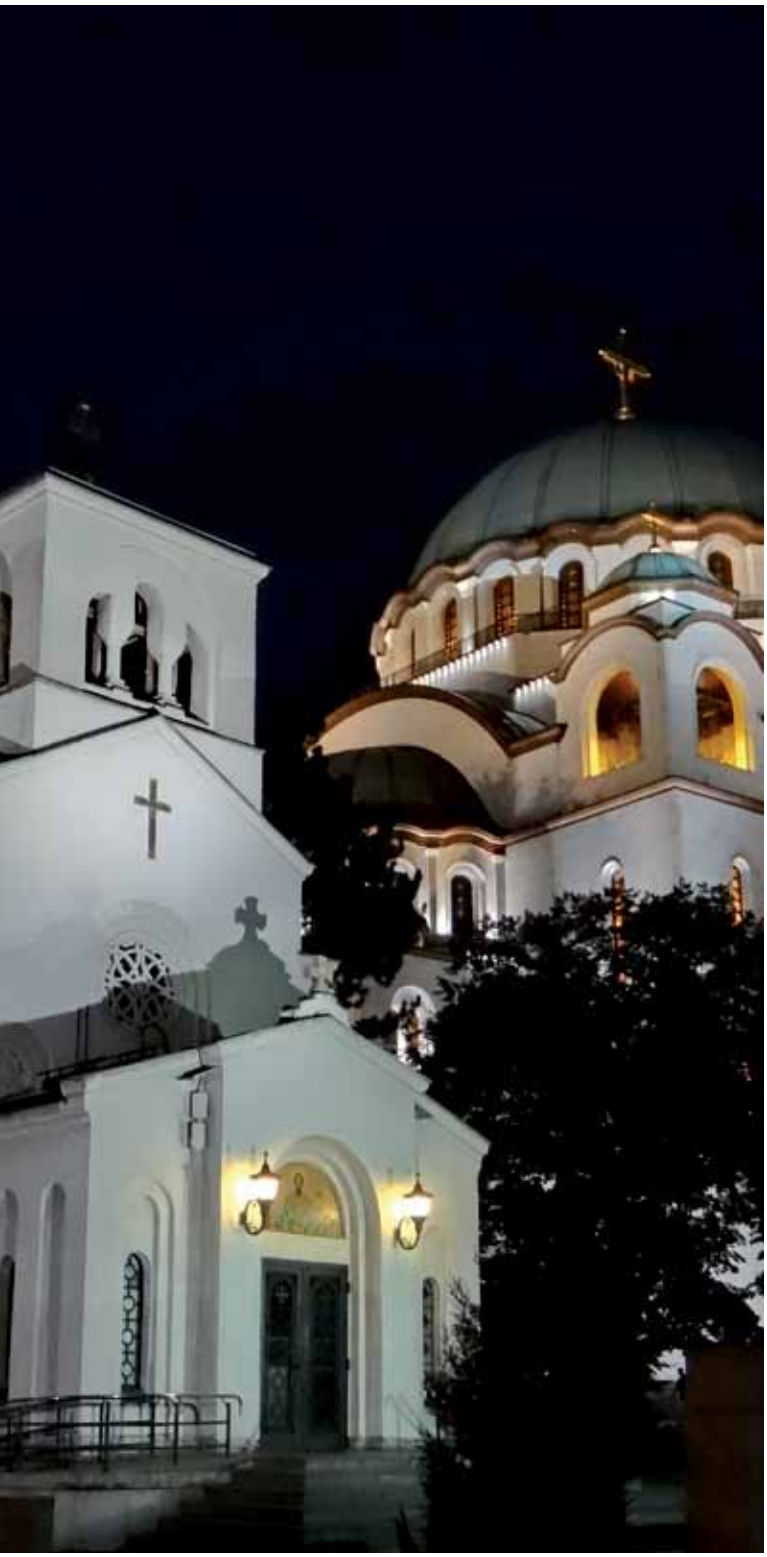
- New electrochemical technologies for water processing (treatment, reuse), materials synthesis and/or recycling.
- Electrokinetic soil remediation.
- Electrochemical technologies for air emission control and carbon dioxide utilization.
- Advanced sustainable electrode materials and structures.
- Life-cycle analysis demonstrating the impact of electrochemistry in sustainable manufacturing and/or green chemistry.
- Advanced cell and system design, including reactant and product flow, heat transfer, and stack level materials corrosion.
- Electrochemical performance and cell characterization.
- Development and optimization of the energy conversion and storage processes.
- Applications and economic analysis.
- Scale up demonstration of novel electrochemical processes.

Symposium Organizers

Gerardine Botte (Coordinator), *Ohio University, USA*
Manuel Rodrigo, *University de Castilla La Mancha, Spain*
Vladimir Panić, *University of Belgrade*
Gyozo Lang, *Eötvös Loránd University, Budapest, Hungary*

Symposium 13

Electrochemistry in the digital age: model-supported process analysis and design



Sponsored by: Division 5, Electrochemical Process Engineering and Technology
Division 3, Electrochemical Energy Conversion and Storage
Division 7, Physical Electrochemistry

The 21st century is becoming a century of digitalization, where phenomena at surfaces up to industrial processes are analyzed via mathematical modeling, and where technologies are designed, optimized, and monitored with virtual tools. Electrochemical technologies entail intricate interactions and correlations at material to system level. In this realm, modeling provides crucial insights and tools to precipitate advances in materials properties and cell performance and interpret electrochemical measurement data. Also, the route from the discovery of electrochemical principles to highly performing systems and devices requires multiple informed choices, where model-assisted analyses and design play a role.
This symposium aims at discussing these aspects and surveying the recent progress in established or emerging modeling methods and approaches, ranging from computational chemistry and continuum or mean field models to hybrid and data driven methods. It will provide a forum for vibrant scientific exchange among electrochemical engineering, physical electrochemistry and various fields of application, such as in energy and sensor technologies.

Symposium Organizers

Ulrike Krewer (Coordinator), *TU Braunschweig, Germany*
Michael Eikerling, *Simon Fraser University, BC, Canada*
Adam Weber, *Lawrence Berkeley National Lab, USA*
Igor Pašti, *University of Belgrade, Serbia*

Symposium 14

Future of molecular electrochemistry

Sponsored by:
Division 6, Molecular Electrochemistry

In recent years, there has been a tremendous resurgence in the field of electrochemical transformations at the molecular level, promoted inter alia, by the development and exploitment of new electrode materials, media, cell configurations and/or of new electrosynthetic strategies, affording new products or improved performances in terms e.g. of improved yield and/or selectivity, lower costs, simpler synthetic pathways and/or better ecocompatibility; by the increasing need of understanding and rationalizing the electron transfer mechanisms involving complex electroactive organic, organometallic or coordination molecules or related materials to master and optimize their application in e.g. molecular electroanalysis, molecular electrocatalysis, molecular material science, molecular optoelectronics/non-linear optics/chiroptics/spintronics, molecular (bio) energetics, molecular media (ionic liquid/liquid crystals/DES...), as well as biology, pharmaceutics, and medicine. The Symposium devoted to the present and future of molecular electrochemistry will therefore cover a broad range of topics including, but not limited to

- fundamental investigations on the mechanisms of action or transformation of the above molecules or molecule materials, on their reactivity initiated by electron transfer and on the relationship between structure and redox properties.
- new tools, protocols and/or strategies for bond activation by ET for (electro)synthetic purposes:;
- investigation, also by application of combined techniques and combining experimental data with theoretical computantions, of the electronic features of complex molecules and molecular systems, dealing e.g. with issues like intramolecular electronic communication, multiple interacting redox centres, host-guest interactions, electrochromism, redox properties affected by conformation change, stereoelectrochemistry, enantioselectivity at electrochemical interphases, toelectrochemistry, etc.

Symposium Organizers

Patrizia Romana Mussini (Coordinator), *Universita degli Studi di Milano, Italy*
Marília Oliveira Fonseca Goulart, *Universidade Federal de Alagoas, Brazil*
Jiří Ludvík, *J. Heyrovský Institute, Czech Republic*

Symposium 15

When Molecular Electrochemistry Meets Luminescence: from Fundamentals to Analytical Applications

Sponsored by:
Division 6, Molecular Electrochemistry
Division 1, Analytical Electrochemistry

In recent years, the combination of molecular electrochemistry and luminescence has begun to show significant potential for the development of new superior analytical strategies. Accordingly, this symposium will address fundamental aspects, recent developments and (bio)analytical applications of redox molecules (organic, organometallic, coordination compounds) possessing luminescent properties. This symposium will cover a broad range of topics including, but not limited to: electrofluorochromism, electrogenerated chemiluminescence (ECL), new molecular luminophores, mechanistic investigations, the development of new enabling instrumentation for coupling of electrochemistry and luminescence, simulation and theoretical aspects of related phenomena, sensors and biosensors based on electrochemistry and luminescence. The purpose of this symposium is thus to bring together the leading scientists working in all these aspects, in order to stimulate intensive discussion and initiate/improve collaborations.

Symposium Organizers

Olivier Buriez (Coordinator), *Ecole Normale Supérieure de Paris, France*
Guobao Xu, *Chinese Academy of Science, China*
Conor Hogan, *La Trobe University, Australia*
Neso Sojic, *Université de Bordeaux, France*
Rastko Vasilić, *University of Belgrade, Serbia*

Symposium 16

Two-Dimensional Materials: An Electrochemical Perspective

Sponsored by:
Division 7, Physical Electrochemistry
Division 4, Electrochemical Materials Science

Two-dimensional (2D) materials possess a range of unique properties that represent the ultimate limit for a range of known phenomena and existing applications, and present opportunities for new disruptive technologies. Realisation of these opportunities requires a fundamental-level understanding of the electrochemical fabrication, responses, performance and applications of these materials. This symposium seeks to deliver these and to point the way forward to intellectual insights of importance for both the scientific and industrial communities. *The symposium will cover recent advances in physical and interfacial aspects of 2D material electrochemistry, including:*

- Electrochemical charge transfers at 2D material interfaces
- Electrochemical in-situ probes at 2D material interfaces
- Transport through 2D materials
- Reaction in confined environments within 2D materials
- 2D heterostructural and (electro)chemical properties
- Engineering 2D materials for electrochemical applications
- Novel 2D crystal-based electrochemical devices

Symposium Organizers

Robert Hillman (Coordinator), *University of Leicester, UK*
Shen Ye, *Tohoku University, Sendai, Miyagi, Japan*
Nakkiran Arulmozhi, *Leiden University, The Netherland*
Csaba Janaky, *University of Szeged, Hungary*

Symposium 17

Electroactive materials: polymers, inorganic solids, nanocomposites and hybrid materials

Sponsored by:
Division 4, Electrochemical Materials Science

The symposium is designed to cover an extensive area of various electroactive materials and composites of electrochemical interest, including conducting/conjugated/redox polymers, mixed electron-ion inorganic conductors, mixed-valence inorganic solids, lithium-ion intercalation materials, various electroactive composite materials, etc. Both their synthesis and applications will be among topics of this symposium. Special accent will be made on original concepts for the generation of electroactive materials, on systems possessing unusual properties, on their advanced applications in molecular electrochemistry, electroanalysis, (electro)catalysis, (bio) sensors, actuators, drug delivery, energy storage and electrochromic devices, solar energy conversion, micro- and nanoelectronics, radical scavenging, corrosion protection, etc., as well as on the relationships between their structure, properties and performance in applications.

Symposium Organizers

Marijana Kraljić Roković (Coordinator), *Faculty of Chemical Engineering and Technology, Zagreb, Croatia*
Mikhail A. Vorotyntsev, *M. V. Lomonosov Moscow State University, Russia and University of Burgundy and Franche-Compte, Dijon, France*
Jürgen Heinze, *University of Freiburg, Institute for Physical Chemistry,Freiburg, Germany*
Gordana Ćirić-Marjanović, *University of Belgrade, Serbia*

Symposium 18

Nanoelectrochemistry and electrocatalysis – from fundamentals to applications

Sponsored by:
Division 1, Analytical Electrochemistry
Division 7, Physical Electrochemistry
Division 2, Bioelectrochemistry
Division 3, Electrochemical Energy Conversion and Storage
Division 4, Electrochemical Materials Science

Reactions at complex real systems in sensing, energy conversion and others are characterized by significant heterogeneity. Their properties cannot be resolved accurately when averaging techniques are applied. One way to circumvent this problem is to model the real system by idealized systems, as is e.g. done when single crystal surfaces are used, which also can by methods developed in surface science, like STM. The other option is the utilization of nanoelectrodes or nanoarchitectures enabling electrochemical analysis across different scales in both size and concentration, even down to nanometer scales and the single entity level. The same methods can be applied to study living systems, which are inherently heterogeneous and elucidate this diversity down to the level of individual cells. To even further characterize and understand these complex systems it is often required to apply orthogonal analytical methods, including scanning electrochemical, super resolution and electron microscopy. The symposium covers the entire spectrum of electrocatalytic reactions, nanosensors, nanoelectrode fabrication, spatially resolved measurements and theoretical work. The organizers wish to bring together researchers working on fundamental model systems for fuel cells, electrolyzers, metal-air batteries and artificial photosynthesis including nanoelectrochemical techniques for sensing, electrocatalysis, materials science, and biology and theoretical description thereof.

Topics of interest include, but are not limited to, fundamental research on:

- Electrocatalysis of oxygen, nitrogen, carbon, chloride, as well as oxidation and hydrogenation of small organic molecules
- Electrocatalytic reactions in aqueous and non-aqueous electrolytes, ionic liquids and water in salt.
- Electrocatalyst materials such as metals, oxides, nitrides, phosphides, chalcogenides comprising nanoparticles, nanostructures or single crystals
- Bio-inspired electrocatalysts with relevance to artificial photosynthesis
- Mechanistic studies, property-activity relationships, property-selectivity relationships and property-stability relationships
- Combined electrocatalytic and spectroscopic studies
- Theoretical work on all time and length scales
- Sensor design and simulation to enhance sensitivity, improve selectivity and/or gain greater stability
- Novel device fabrication methodologies and materials for sensing applications
- Electrochemical surface imaging techniques and combinations with other methods
- Investigation of biological objects down to single entities

Symposium Organizers

Marcel Risch (Coordinator), *Helmholtz Center for Materials and Energy, Germany*
Paolo Actis, *University of Leeds, UK*
Helmut Baltruschat, *University of Bonn, Germany*
Symeon Bebelis, *University of Patras, Greece*
Annamaria Miko, *Koç University, Turkey*
James Rohan, *Tyndall National Institute, Ireland*
Kristina Tschulik, *Ruhr-University Bochum, Germany*

Symposium 19

Electrochemical surface and interface

Sponsored by:
Division 7, Physical Electrochemistry

Developing a complete atomistic picture on the complex interrelation between charge transfer, chemical conversion and interfacial potential in the presence of an electrolyte is one of the most imminent challenges in electrochemistry. At the same time, understanding the electrochemical interface at the atomic and molecular level is crucial for the design of new materials and optimization of electrochemical processes. This symposium will provide an interdisciplinary forum to discuss recent developments in experimental and theoretical electrochemistry that aim at a fundamental understanding of interface phenomena relevant for energy conversion and storage, chemical electrosynthesis and material preparation. It will provide a platform, for both electrochemistry and surface science community, to present and debate different key fundamental areas of electrochemical surface science. Main topics will be: structure-reactivity and structure-selectivity relationships, reaction mechanisms and kinetics, adsorption processes, new methods for imaging the electrochemical interface and reactive species, theoretical models and calculations, solvents and electrolyte effects, synthesis and characterization of new materials from thin-films to nanostructures.

Symposium Organizers

Paramaconi Rodriguez, (Coordinator), *University of Birmingham, UK*
Enrique Herrero, *University of Alicante, Spain*
Katrin Domke, *Max Planck Institute for Polymer Research, Germany*
Julia Kunze-Liebhäuser, *University of Innsbruck, Austria*
Natasa Vasiljević, *University of Bristol, UK*
Daria Vladikova, *Institute of Electrochemistry and Energy Systems – BAS, Bulgaria*

Symposium 20

Cutting Edge Electrochemical Measurement Techniques

Sponsored by:
New topics division
Division 1, Analytical Electrochemistry
Division 2, Bioelectrochemistry
Division 3, Electrochemical Energy Conversion and Storage
Division 7, Physical Electrochemistry

Precision measurements and advanced characterization techniques are critically important in understanding electrochemical processes at the interfaces or within the bulk of materials. Cutting edge measurement and characterization tools are being developed and incorporated in electrochemical researches. This symposium aims at providing a merging discussion forum for advanced measurement techniques and various scientific problems across subfields of electrochemistry. The goal of the symposium is to promote cross-disciplinary exchange of ideas to inspire and fuel future electrochemical research with advanced measurement and characterization tools. The scope of the symposium includes the following advanced in situ or in-operando characterization techniques applied for studying electrochemical systems and processes related to health, energy, environment, etc.:

- Novel electrochemical techniques
- Scanning probe microscopies
- Electron microscopies
- Lab-based spectroscopies
- Synchrotron-based techniques
- Neutron-based techniques
- Free electron laser-based techniques
- Other advanced techniques for precision measurements

Symposium Organizers

Liwei Chen, (Coordinator), *Shanghai Jiaotong University, China*
Bin Ren, *Xiamen University, China*
Olaf Magnussen, *Kiel University, Germany*
Alexandre Bastos, *University of Aveiro, Portugal*
Jose Solla-Gullon, *University. of Alicante, Spain*

Symposium 21

Education and transmission of knowledge from the past to the new generations of electrochemists

Sponsored by:
All Divisions

After successful symposia on education during previous ISE annual meetings held recently in Mexico (2013) and the USA (2017), the objective of this Symposium is a transmission of knowledge from prominent electrochemists (chosen as key note and/or invited lecturers), having large experimental and theoretical background, to new generations of electrochemists.
Following O'Mara Bockris's sentence: "Looking back to look forward", particular ambition of this symposium is to obtain a better perspective on future efforts in electrochemical education, research and applications.

The symposium topics cover, but are not limited to:

- "Looking back to look forward" Transfer of knowledge from prominent electrochemists to the coming generations of electrochemists.
- Teaching Electrochemistry in the frame of General Chemistry course - what to offer?
- Teaching Electrochemistry in the frame of physical chemistry course – what to offer?
- Creation of electrochemistry courses for different levels of studying - what students know when they enter and what they need to know to complete the course.
- From general to highly specialized courses in electrochemistry
- New teaching tools in electrochemistry education.
- Concepts and strategies in electrochemical education.
- Experience in teaching and examination - Effect of adopted knowledge.
- The importance of experiments in teaching electrochemistry.
- Combining teaching transport phenomena, chemical catalysis (homogenous and heterogenous) and chemical reactors design with electrochemistry and electrochemical engineering.
- Electrochemical education of engineers and scientists-what is the difference?
- Combining Electrochemistry and Computational Chemistry
- Modeling Electrochemical Reactions Using Density Functional Calculations

Symposium Organizers

Christos Comninellis, (Coordinator), *EPFL, Switzerland*
Hasuck Kim, *Seoul National University, Korea*
Velizar Stanković, *University of Belgrade, Serbia*
Aleksandar Zeradjanin, *University of Bremen, Germany*
Laszlo Peter, *Hungarian Academy of Sciences, Hungary*

Symposium 22

General Session

Sponsored by:
All Divisions

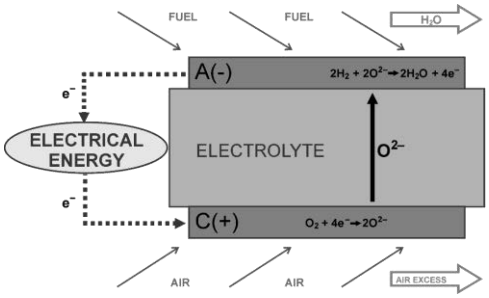
This Symposium will cover all ISE areas not compatible with topical symposia.

Symposium Organizers

Jun Chen (Coordinator), *Nankai University, China*
Woonsup Shin, *Sogang University, South Korea*
Jelena Lović, *University of Belgrade, Serbia*
Vladislava Jovanović, *University of Belgrade, Serbia*

Solid state ionic conductors based on Lu-doped δ-Bi_2O_3

A. Petričević[1], A. Malešević[2], A. Radojković[2], M. Žunić[2], G. Branković[2], A. Dapčević[1]
[1]*Faculty of Technology and Metallurgy, Karnegijeva 4, Belgrade, Serbia*
[2]*Institute for Multidisciplinary Research, Kneza Višeslava 1a, Belgrade, Serbia*
aleksandar.petricevic27@gmail.com



Regarding limited fossil energy resources and hence the increasing demands for new highly efficient and environmentally friendly energy conversion devices, the widespread use of solid oxide fuel cells (SOFCs) might become a keystone in near future. An SOFC is consisted of dense electrolyte which is sandwiched between two porous electrodes. Since the electrolyte is the most important part of an SOFC, oxide ion conductors applicable in SOFCs became the hot topic of modern research. The main requirement is to find a stable dense electrolyte material with increased conductivity at intermediate temperature. Two commercial electrolytes, yttria stabilized zirconia (YSZ) and gadolinia doped ceria (GDC), are far to be ideal. The use of YSZ requires operating temperatures above 1000 °C while devices based on GDC are not efficient enough due to GDC lower conductivity at intermediate temperatures.

The best candidate for an electrolyte in intermediate temperature SOFCs is undoubtedly fluorite structured bismuth oxide, i.e. δ-Bi_2O_3, being the fastest known ionic conductor. However, this material is unstable upon heating/cooling but the use of dopant, such as Tm, led to the impressive stability and high conductivity at intermediate temperatures [1]. Our findings indicated that Lu-doped δ-Bi_2O_3 could show even better performances since Lu is smaller and more rigid dopant than Tm.

In this study, the possibility to stabilize δ-Bi_2O_3 in Bi_2O_3–Lu_2O_3 system was investigated. Two starting mixtures of α-Bi_2O_3 and Lu_2O_3 with the following compositions $(Bi_{1-x}Lu_x)_2O_3$, x = 0.20 and 0.25, were dry homogenized in an agate mortar, heat treated at 750 °C for 3 h and then slowly cooled. The obtain powders were characterized by XRD and DTA techniques. Based on these results, the targeted cubic single-phase δ-Bi_2O_3 was successfully obtained within both systems. The unit cell parameter of obtained Lu-doped δ-Bi_2O_3 decreases as the dopant content increases, as expected since Lu^{3+} is smaller cation than Bi^{3+}. According to cyclic DTA curves, no phase transitions (25 – 980 °C) were observed for both phases, $(Bi_{0.8}Lu_{0.2})_2O_3$ and $(Bi_{0.75}Lu_{0.25})_2O_3$, indicating that these δ-Bi_2O_3 phases are stable.

Afterwards, half of obtained quantity of each powder was mechanochemically treated (in planetary ball mill Retsch PM-100) in order to decrease the crystallite size. Namely, before performing EIS measurements the powders undergo to pressing and then sintering to obtain dense ceramic pellets. This is also important for their future application in SOFC since the density of almost 100% is mandatory in order to avoid the direct contact of air (oxygen) and fuel (hydrogen). The density of sintered pellets obtained from both untreated and mechanochemically treated powders will be compared. Using EIS technique, the ionic conductivity will be measured for the samples having the highest density. We expect that these materials will exhibit the conductivities which are higher than those obtained for Tm-doped δ-Bi_2O_3 (0.1 – 0.4 S cm^{-1} at 550 – 800 °C).

Such stability and extraordinary conductivity would open the possibility for application of $(Bi_{0.8}Lu_{0.2})_2O_3$ and $(Bi_{0.75}Lu_{0.25})_2O_3$, which could result in the significant enhancement of electrochemical performance of intermediate temperature SOFCs but also in their good stability over long time service.

[1] A. Dapčević, D. Poleti, J. Rogan, A. Radojković, M. Radović, G. Branković, A new electrolyte based on Tm^{3+}-doped δ-Bi_2O_3-type phase with enhanced conductivity, *Solid State Ionics* 280 (2015) 18–23.