# 70<sup>th</sup> Annual Meeting of the International Society of Electrochemistry

4 - 9 August 2019 Durban, South Africa

Electrochemistry: Linking Resources to Sustainable Development



http://annual70.ise-online.org e-mail: events@ise-online.org



### Invitation to ISE 2019

You are warmly invited to the **70<sup>th</sup> Annual Meeting International Society of Electrochemistry** to be held in Durban, South Africa from 4 to 9 August 2019. The meeting will be hosted at the Durban International Convention Centre (Durban ICC).

Durban, a coastal city in eastern South Africa's KwaZulu-Natal province, is known for its African, Indian and colonial influences. The city captures the heart of many with its buzzing, vibrant atmosphere, melting pot of cultures and warm hospitality. Durban boasts the so-called "golden mile", 6 km of sandy beaches, the iconic Moses Mabhida Stadium and the famed Ushaka Marine World, to mention a few of its attractions.

### Summary of Symposia

Symposium 1	Recent Trends in Electroanalysis and Low-Cost Electrochemical Sensors
Symposium 2	Sensors and Biosensors for Biomedical and Environmental Applications
Symposium 3	Fuel Cells, Biofuel Cells and Electrolyzers
Symposium 4	Renewable Energy and Photo-Electrochemistry
Symposium 5	Gold and Related Noble Metals in Electroanalysis, Electrocatalysis, and Electrochemical Devices
Symposium 6	Advances in Bioelectrochemistry
Symposium 7	Novel Energy Storage Materials and Devices: Batteries for Powering Tomorrow's World
Symposium 8	Sustainable Resources, Processes and Design of High Power Supercapacitors
Symposium 9	Electro-physical Chemistry and Application of Platinum Group Metals
Symposium 10	New Concepts and Opportunities in Electrochemical Synthesis: Fundamentals, Methods and Applications
Symposium 11	The Science, Technology and Engineering of Corrosion
Symposium 12	Electrochemical Technology for Water and the Environment for Social, Health and Economic Development
Symposium 13	Electrografting of Materials: from Fundamentals to Applications
Symposium 14	Molecular Electrochemistry: from Fundamentals to Applications
Symposium 15	Computational Electrochemistry and Simulation: from Prediction of Properties to Optimization of Devices
Symposium 16	Spectroscopy, Microscopy and Theory for the Rational Design of Electrochemical Interfaces
Symposium 17	Electrochemical Technologies for Sustainable and Advanced Manufacturing
Symposium 18	Electrochemistry and Mining: Minerals and Metal Processing
Symposium 19	Imaging Heterogeneous Electrochemical Processes: From Single Molecules and Nanoparticles to Vesicles and Cells
Symposium 20	Carbon – A Starring Role in Electrochemistry
Symposium 21	General Session



### Organizing Committee

Christian Amatore, Paris, France Priscilla Baker, Cape Town, South Africa Justin Gooding, Sydney, Australia Marilia Goulart, Maceio, Brazil Pieter Levecque, Cape Town, South Africa Janice Limson, Grahamstown, South Africa (Co-chair) Mkhulu Mathe, Pretoria, South Africa (Co-chair) Kenneth Ozoemena, Johannesburg, South Africa (Chair) Zhong-Qun Tian, Xiamen, China Gunther Wittstock, Oldenburg, Germany

### 2018 ISE Prize Winners and Award Lecturers

Electrochimica Acta Gold Medal Juan Miguel Feliu Martínez, University of Alicante, Alicante, Spain ISE-Elsevier Prize for Experimental Electrochemistry Yu Huang, University of California Los Angeles, USA Bioelectrochemistry Prize of ISE Division 2 David Waldeck, University of Pittsburgh, USA Brian Conway Prize for Physical Electrochemistry Patrice Simon, Université Paul Sabatier, Toulouse, France Jaroslav Heyrovsky Prize for Molecular Electrochemistry Siegfried Waldvogel, Johannes Gutenberg University, Mainz, Germany Tajima Prize Stefan Freunberger, Graz University of Technology, Austria ISE-Prize for Electrochemical Material Science Peng Bai, Washington University in St. Louis, USA Zhaowu Tian Prize for Energy Electrochemistry Fabio La Mantia, Universität Bremen, Germany ISE-Elsevier Prize for Green Electrochemistry Emmanuel Mousset, CNRS/University of Lorraine, Nancy, France ISE-Elsevier Prize Applied Electrochemistry Kyle Smith, University of Illinois at Urbana-Champaign, USA Early Career Analytical Electrochemistry Prize of ISE Division 1 Maria Cuartero Botia, KTH Royal Institute of Technology, Stockholm, Sweden Oronzio and Niccolò De Nora Foundation Young Author Prize Cigdem Toparli, Massachusetts Institute of Technology, Cambridge, USA



# Plenary Lecturers

### Sir Fraser Stoddart, Northwestern University, USA



Fraser Stoddart is a Nobel Prize-winning scientist, Board of Trustees Professor and Director of the Center for the Chemistry of Integrated Systems at Northwestern University. He received his BSc (1964) and PhD (1966) from Edinburgh University, and went to Queen's, Sheffield, Birmingham University and UCLA before joining the Northwestern University (2008). He was the first to successfully synthesize a mechanically interlocked molecule, known as a catenane, thereby helping to establish the field of mechanical bond chemistry. Stoddart's research enabled the development of self-assembly processes and template-directed synthesis for the generation of a variety of mechanically interlocked molecules, the movements of which can be controlled. Such molecules have a wide range of applications, including as components of drug-delivery systems, electronic sensors, and motorized devices. His work has been recognized by many awards, medals and honorary doctorates. The first and the latest of his awards were from the Carbohydrate Chemistry Award of The Chemical Society (1978) and the Nobel Prize in Chemistry (2016), which he shared with French chemist Jean-Pierre Sauvage and Dutch chemist Bernard Feringa. He is currently on the international advisory boards of numerous journals, including Chemistry World, ChemPlusChem, Macromolecular Rapid Communications and Organic Letters. He is editor-in-chief of Applied Nanoscience. He is a Fellow of the Royal Society (1994), the German Academy (Leopoldina) of Natural Sciences (1999), the American Association for the Advancement of Science (2005), and the Science Division of the Royal Netherlands Academy of Arts and Sciences (2006). He is a member of the American Academy of Arts and Sciences (2012) and the National Academy of Sciences (2014). He is an honorary fellow of the Royal Society of Edinburgh (2008) and the Royal Society of Chemistry (2011).

### $Peter \ G. \ Bruce, \ {\sf University} \ {\sf of} \ {\sf Oxford}, \ {\sf UK}$



Peter Bruce is a British chemist and Wolfson Professor of Materials in the Department of Materials at the University of Oxford. He is Director of the UK SUPERGEN Energy Storage Hub. He obtained his PhD at the University of Aberdeen (1982). Bruce's primary research interests are in the fields of solid-state chemistry and electrochemistry; particularly solid-state ionics, which embraces ionically conducting solids and intercalation compounds. He is interested in the fundamental science of ionically conducting solids (ceramic and polymeric materials) and intercalation compounds, in the synthesis of new materials with new properties or combinations of properties, in understanding these properties and in exploring their applications in new devices, especially for energy storage such as devices such as rechargeable lithium batteries. Although ionically conducting solids represent the starting point for much of his research, he has extended his interests beyond the confines of this subject alone. His pioneering work has provided many advances. For example, Peter discovered that crystalline polymer electrolytes actually are better conductors than amorphous ones. He used solid-state chemical principles to develop a rechargeable lithium-ion battery that has since revolutionized the electronics industry. He also developed lithium-air batteries that have found uses in electric and hybrid electric vehicles. Peter's outstanding research has been recognized with a number of prestigious awards and fellowships. He received the Tilden Prize of the Royal Society of Chemistry in 2008, the Carl Wagner Award of the Electrochemical Society in 2011 and the 2012 AkzoNobel UK Science Award of the Royal Society of Chemistry.

### Wolfgang Schuhmann, Ruhr-University Bochum, Germany



Wolfgang Schuhmann obtained his diploma degree in chemistry from the University in Karlsruhe, Germany (1982) and his PhD from the Technical University of Munich (1986). After finishing his habilitation thesis at the Technical University of Munich in 1993, he was appointed as Professor of Analytical Chemistry at the Ruhr-Universität Bochum in 1996. His publications in the literature span the breadth of his research interests, addressing micro- and nanoelectrochemistry; development of tools for microelectrochemistry (scanning electroche-mical microscopy); electrochemical robotics and combinatorial electrochemistry; modified electrodes for biosensors, DNA assays; local visualization of electrochemical activity on surfaces with applications in corrosion, material chemistry, electrocatalyst development; fuel cells, biofuel cells, Li batteries, photo¬electrochemistry; carbon nanotubes as electrode materials; electrochemical deposition of catalyst nanoparticles and noble-metal free electrocatalysts. He has received many awards, including the Biosensors & Bioelectronics Award (2000), Julius-von-Haast Fellowship Award of the Royal Society of New Zealand and the Humboldt Foundation (2008), Katsumi-Niki-Award of ISE (2011), Alessando Volta Medal of the Electrochemical Society (ECS, 2018) and the Heyrovsky-Ilkovic-Nernst-Lecture of the GDCh, the Czech and the Slovak Chemical Societies (2014), Professor Schuhmann is Fellow of the Royal Society of Chemistry (FRSC, 2005), Fellow of the ISE (2012), and was the recipient of a Howard Fellowship of the University of New South Wales, Sydney (2014). He has also been a Distinguished Visiting Professor at the University of Medicine and Pharmacy "Iuliu Hatieganu", Cluj-Napoca, Romania (2016), the Schulich Faculty of Chemistry at the Technion - Israel Institute of Technology, Haifa, Israel (2017) and is recipient of the "Schulich Visiting Professor Lectureship" for 2018-19.



#### Tebello Nyokong, Rhodes University, South Africa



Prof Tebello Nyokong obtained her PhD at the University of Western Ontario in Canada in 1987. She is a South African chemist and Distinguished Professor at Rhodes University. Currently she holds the DST/NRF Research Chair in Medicinal Chemistry & Nanotechnology, and is the founding Director of the Rhodes University/DST Centre for Nanotechnology Innovation, housing state-of-the-art tools for studies at the nanoscale. Her research focuses on the areas of photo-dynamic therapy, the synthesis and application of novel metallophthalocyanines, electrochemical sensing and electrospinning of nanofibres for a range of applications. Her research has found application in a range of areas from environmental remediation and water treatment to healthcare and even in the military, several of which are being examined for commercialization. She is the recipient of several awards including the Royal Society of Chemistry/Pan African Chemistry Network Distinguished Women in Chemistry Award (2011), the UNESCO Medal for Contribution to Development of Nanoscience and Nanotechnologies (2015), the ISE Electrochemistry Excellence Award: Teaching & Research (2013) as well as the L'Oreal-UNESCO award for "Women in Science" representing Africa and the Arab States in 2009. Internationally she serves on several bodies and was appointed to the United Nations Secretary-General's High-Level Panel on Technology Bank For Least Developed Countries (2015) and the UNESCO High-level panel on Science, Technology and Innovation for sustainable Development (2011). Her impact on the African continent has been recognized through the Continental Award, the Kwame Nkrumah Scientific Award by the African Union (2016) and the National Research Foundation's "Lifetime Achievement Award" in 2013. For her contributions to science, she was bestowed with the Order of Mapungubwe: Bronze by the State President Mbeki in 2005. The National Center for Research on Human Evolution (CENIEH) in Spain has recognized her as one of the "13 Names to Change the World" (2012).

#### Peidong Yang, University of California, Berkeley, USA



Peidong Yang received a B.S. in chemistry from University of Science and Technology of China in 1993 and a PhD in chemistry from Harvard University in 1997. He did postdoctoral research at University of California, Santa Barbara before joining the faculty in the department of Chemistry at the University of California, Berkeley in 1999. He is currently professor in the Department of Chemistry, Materials Science and Engineering and a senior faculty scientist at the Lawrence Berkeley National Laboratory. He is S.K. and Angela Chan Distinguished Chair Professor in Energy. He was recently elected as MRS Fellow, and as a member of the National Academy of Sciences and American Academy of Arts and Sciences. He is the director for California Research Alliance by BASF, and co-director for the Kavli Energy Nanoscience Institute. He is one of the founding members for DOE Energy Innovation Hub: Joint Center for Artificial Photosysnthesis (JCAP) and served as its north director for the first two years. Yang is an associate editor for the Journal of the American Chemical Society and also serves on the editorial advisory board for a number of journals including Acct. Chem. Res. and Nano. Lett. He was the founder of the Nanoscience subdivision within American Chemical Society. He has co-founded two startups, Nanosys Inc. and Alphabet Energy Inc. He is the recipient of the MacArthur Fellowship, E. O. Lawrence Award, ACS Nanoscience Award, MRS Medal, Baekeland Medal, Alfred P. Sloan research fellowship, the Arnold and Mabel Beckman Young Investigator Award, National Science Foundation Young Investigator Award, MRS Young Investigator Award, Julius Springer Prize for Applied Physics, ACS Pure Chemistry Award, and Alan T. Waterman Award. His main research interest is in the area of one dimensional semiconductor nanostructures and their applications in nanophotonics and energy conversion.

### Electrochimica Acta Gold Medal Juan Miguel Feliu Martínez, University of Alicante, Alicante, Spain



Juan M. Feliu studied Chemistry at the University of Barcelona, graduating in 1973 and earning a Ph. D. degree in Physical Chemistry (Electrochemistry) in 1978. He was promoted to Associate Professor of Physical Chemistry at the same University, and in 1983 moved to the recently created University of Alicante to join the group of Professor A. Aldaz. Once in Alicante, he started a fruitful collaboration with Dr. Jean Clavilier (CNRS, Meudon, France) which served as the basis for his work on single crystal surfaces. He was promoted to Professor (Catedrático) of Physical Chemistry in 1993 at the University of Alicante. Prof. Feliu was the Director of the Institute of Electrochemistry of the University of Alicante (2003-2012). He served as chairman (1999-2002) of Division 1 (Interfacial Electrochemistry) of the International Society of Electrochemistry, and as President of the ISE (2005-2006). In 2000/2001 he served in the IUPAC's Commission I.3 (Electrochemistry). He served as Associate Editor of the Journal of Electrocanalytical Chemistry (2003- July 2015) and is currently Editor-in Chief of this journal.



## **Electrochemistry Tutorials and Masterclasses**

# Tutorial 1

### Computational Electrochemistry

Marc Koper Leiden University

Alexander Oleinick Ecole Normale Superieure

Wolfgang Schmickler Ulm University

#### Tutorial 2 Electrochemical Sensors

Emmanuel Iwuoha University of the Western Cape, South Africa

Daniel Mandler Hebrew University of Jerusalem, Israel

David Williams University of Auckland, New Zealand

### **Electrochemistry Masterclasses**

The Electrochemistry Masterclasses are designed to provide an introduction to both the fundamental and applied aspects of several areas of electrochemistry. Each half-day of the symposium will comprise an invited review lecture to introduce the topic, followed by an invited lecture on methods used in investigating this topic. Topics have been selected to complement the symposia taking place at the annual meeting. The topics are Batteries, Computational Electrochemistry, Corrosion, Electroanalysis and Bioelectrochemistry, Fuel Cells and Water Electrolyzers, and Spectro-electrochemistry. A feature of the Masterclasses will be the opportunity to participate in "electrochemistry speed dating" wherein experts will be available to briefly discuss concepts with participants.

#### Organizers

Andrea E. Russell (Coordinator), University of Southampton (a.e.russell@soton.ac.uk) Caren Billing, University of the Witwatersrand Fabian Ezema, University of Nigeria





Recent Trends in Electroanalysis and Low-Cost Electrochemical Sensors

Sponsored by : Division 1, Analytical Electrochemistry

New research in analytical electrochemistry is driven by the quest for better understanding and more effective measurement of the world around us. Recent developments are aimed at lower detection limits, faster analyses, lower cost, automated and more portable systems. To achieve this, much effort is centered on the elaboration of electrodes with enhanced sensitivity, improved selectivity and greater stability. Research continues on new strategies for monitoring and quantifying emergent analytes of biological or environmental importance. Recent developments in the field are related, but not limited, to lab-on-a-chip devices and single-use sensors, paper-based electrodes, wearable or smartphone-based electrochemical (bio) sensors. This symposium will highlight recent advances in all of these areas.

#### Symposium Organizers

Alain Walcarius (Coordinator), Nancy University (alain.walcarius@univ-lorraine.fr) Pedro Estrela, University of Bath Emmanuel Iwuoha, University of Western Cape Ritu Kataky, University of Durham

# Symposium 2

Sensors and Biosensors for Biomedical and Environmental Applications

Sponsored by: Division 1, Analytical Electrochemistry Division 2, Bioelectrochemistry

Disease profiling and its early detection, is a huge priority within the Southern African and African continent. Tuberculosis, HIV/AIDS, malaria, waterborne diseases, as well as cancer are among the leading health conditions that continue to impact on population health and economics of many African countries. In addition, the environmental monitoring of aquatic system is of especial interest in this region. Early and reliable diagnosis is thus of strategic interest. Diverse analytical strategies, often coupled to electrochemical characterization and quantification, are employed in many analytical laboratories. Increasingly, point-of-care systems have become a core focus to meet these challenges.

The themes that this joint symposium addresses cover the following:

- Electroanalytical sensors for nucleic acids, lipids, carbohydrates, small molecules, but also bacteria or viruses
- Biosensors for therapeutic monitoring of drug metabolism linked to real-time profiling of patients' responses to drugs in order to avoid toxicity or ineffective treatment.
- Electrochemical devices and techniques for immunosensing
- Electrochemical cytometry
- Ecofriendly power sources for miniaturized electrochemical sensors
- Cost-effective microfluidic plans for biosensing and environmental analysis
- Analytical tools and methods for food, livestock, public hygiene
- Other biosensors and electroanalytical devices for environmental analysis of the analytes that are not limited to the list above

#### Symposium Organizers

Taek Dong Chung (Coordinator), Seoul National University (tdchung@snu.ac.kr) Priscilla Baker, University of the Western Cape Ronen Fogel, Rhodes University Anthony Guiseppi-Elie, Clemson University



### Fuel Cells, Biofuel Cells and Electrolyzers

# Symposium 4

Renewable Energy and Photo-Electrochemistry

Sponsored by: Division 2, Bioelectrochemistry Division 3, Electrochemical Energy Conversion and Storage

This symposium focuses on all types of low, middle and high temperature fuel cells including enzymatic and microbial fuel cells, as well as electrolyzers for the production of hydrogen.

This symposium includes:

- Synthesis and characterization of novel materials and new cell components for these fuel cells and water electrolysis devices for low-, medium- and hightemperature applications.
- Electrocatalysts, bioinspired and biocatalysts for oxygen reduction, hydrogen oxidation, organic redox system, other fuels and oxidants usable by biocatalysts, oxygen evolution, and hydrogen evolution.
- Ion conductive membrane, separator and ionomers for fuel cells and biofuel cells, water electrolysis systems, and CO<sub>2</sub>/water co-electrolysis systems, especially synthesis and characterization of polymeric, ceramic, ionic liquid and nanocomposite systems.
- Understanding of electrochemical and chemical reactions for the degradation of materials and components of these fuel cells and electrolyzers in low-, middle- and high-temperature applications.
- Operando (in situ) observation for phenomena in these fuel cells and electrolyzers, theoretical studies and computational modeling of functional materials and cell components.

#### Symposium Organizers

Kiyoshi Kanamura (Coordinator), Tokyo Metropolitan University (kanamura@tmu.ac.jp) Marian Chatenet, LEPMI Pieter Levecque, University of Cape Town Elisabeth Lojou, CNRS, BIP Peter Strasser, Technische Universitaet Berlin Hiroyuki Uchida, University of Yamanashi

#### Sponsored by:

Division 3, Electrochemical Energy Conversion and Storage Division 4, Electrochemical Materials Science Division 6, Molecular Electrochemistry

#### Materials electrochemistry plays a critical role in harnessing and storing solar energy as well as in solar device fabrication and application. This symposium is focused on the various aspects of photo-electrochemical energy conversion, from fundamental concepts and materials design and synthesis to solar devices and integration. Studies on thin film semiconducting materials, including bandgap engineering using various doped binary and ternary oxides or sulfides for improved optical absorption properties, and fast charge-transport are primary focus areas of this symposium. The symposium aims to bring together scientists from different areas working on different aspects of such photo-induced electrochemical systems or on basic investigations clarifying the influence of light on electrochemical reactions.

The scope of the symposium includes:

- Photovoltaics
- Dye-sensitized solar cells
- Photo-bio-inspired mechanisms and biomimetic approaches,
- Perovskite solar cells
- Photo-electrocatalysis and photo-water-splitting
- Semiconductors and thin film solar cell
- Photobioelectrodes
- Photoelectrochemical fuel production (hydrogen, methanol, formiate)
- Triggering electrochemical conversions by light
- Plasmonic electrochemistry Photoelectrochemical sensing.

#### Symposium Organizers

Federico Rosei (Coordinator), INRS, EMT (rosei@emt.inrs.ca) Baodan Liu, IMR, Chinese Academy of Sciences Csaba Janaky, University of Szeged Frank Marken, University of Bath Malik Maaza, iThemba LABS, UNISA Mmantsae Diale, University of Pretoria



Gold and Related Noble Metals in Electroanalysis, Electrocatalysis, and Electrochemical Devices

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

Gold is a key South African resource. Together with related noble metals Ag and Cu, it provides a ubiquitous and precious tool in electrochemistry. In fact, they can be regarded as key electrode and/or active materials (as nanoparticles and in complexes) in electrocatalysis, electroanalysis, and an increasingly wide range of advanced electrochemical devices. The Symposium will collate related studies, often of interdisciplinary character and applicative interest, dealing with topics including, but not limited to the:

- investigations of the features of Au, Ag and Cu as electrode surfaces and of their specific interactions with electroactive molecules, with related applications in molecular electrocatalysis and electroanalysis;
- applications in electroanalysis, as electrodes, or as components of composite materials (including nanoparticles) for electrochemical sensors;
- applications in spectroelectrochemistry and electroluminescence (e.g. SERS)
- applications as active materials in other electrochemical devices

#### Symposium Organizers

Patrizia Mussini (Coordinator), Università degli Studi di Milano (patrizia.mussini@unimi.it) Munkombwe Muchindu, Mintek Francesco Paolucci, University of Bologna Jessie Pillay, NMISA Alain Walcarius, Nancy University





### Advances in Bioelectrochemistry

# Symposium 7

Batteries for Powering Tomorrow's World

Sponsored by: Division 2, Bioelectrochemistry

The goal of this symposium is to present and discuss important and exciting new trends in bioelectrochemistry - both fundamentals and applications. Theoretical and experimental approaches in the study of mechanisms and kinetics of electrode processes of proteins and nucleic acids are invited, including long-range electron transfer reactions in biological systems and their technological applications. Bioelectrode design will be the focus as well as methods used to characterize the electrode surfaces with molecular resolution. Applications of bioelectrochemistry including bio-electrocatalysis, bioelectroanalysis and bioelectronics will be emphasized. Novel applications of bioelectrochemistry in medicine and environmental protection are invited.

Topics include but are not limited to:

- Electron transfer in biological systems
- Electrode reactions of redox proteins/enzymes
- Modification of interfaces with biological structures and biomimetics
- Electrochemical transport through membrane and its mimics
- Enzyme, biomembrane, organelle, and whole cell bioelectrochemistry
- Photosynthesis and electrochemistry
- Electrochemistry of nucleic acids

#### Symposium Organizers

Renata Bilewicz (Coordinator), University of Warsaw (bilewicz@chem.uw.edu.pl) Rachel Fanelwa Ajayi, University of the Western Cape Elena Ferapontova, Aarhus University Justus Masa, Ruhr-Universitaet Bochum Seiya Tsujimura, University of Tsukuba Sponsored by: Division 3, Electrochemical Energy Conversion and Storage

The next generation of advanced rechargeable batteries will continue to rely on the maturing Li-ion chemistry, possibly with the integration of alloying, conversion and conversion-alloying anode materials. Innovative doping and coating of active electrode materials are expected to enhance safety, power and energy performance. Post Li-ion systems - such as Li-S, Li-NCM, Na-ion, etc. - are expected to enter the market, however, in the foreseeable future. Irrespective of the technology, the development of a detailed understanding of the fundamental properties of battery materials and the interactions of these materials with their environment will be the key to further improvements in the energy density, safety, and lifetime of batteries. The electrolyte is also crucial for the improvements of these devices, especially with respect to the overall battery safety. This symposium is therefore devoted to recent progress in the fundamental science related to batteries, especially for advanced battery systems. Studies related to all other (applied) aspects of batteries, including solid-state electrolytes, are also welcome.

#### Symposium Organizers

Stefano Passerini (Coordinator), Karlsruhe Institute of Technology (stefano.passerini@kit.edu) Mesfin Kebede, CSIR Robert Kostecki, Lawrence Berkeley National Laboratory Hiten Parmar, Nelson Mandela University



Sustainable Resources, Processes and Design of High Power Supercapacitors

Sponsored by: Division 3, Electrochemical Energy Conversion and Storage

This symposium will cover all fundamental and practical aspects of electrochemical capacitor research, development and applications with a focus on the use of raw materials and precursors from industrial, agricultural and civil waste resources. Basic studies on supercapacitor new materials, interfaces and processes are welcome. Novel characterization techniques, including in situ and in operando methods, and modelling studies are considered.

The use of supercapacitors to improve the exploitation of renewable energy sources for different applications: for remote areas and grid electric quality, will be a topic. New concepts and new devices for applications ranging from micro- to large-size energy storage, with attention to materials and system integration, will be included.

#### Symposium Organizers

Francesca Soavi (Coordinator), University of Bologna (francesca.soavi@unibo.it)

Daniel Belanger, Universite du Quebec a Montreal Katlego Makgopa, Tshwane University of Technology Ncholu Manyala, University of Pretoria



### Symposium 9

Electro-physical Chemistry and Application of Platinum Group Metals

Sponsored by: Division 4, Electrochemical Materials Science Division 5, Electrochemical Process Engineering and Technology Division 7, Physical Electrochemistry

Over 98% of the world's supply of platinum group metals (PGM) comes from just three countries, South Africa, Canada and Russia, with the first dominating the western world supply of Pt. It is only fitting that this symposium should be held in Durban.

PGMs present a somewhat similar physical chemistry, but exhibit a rich coordination chemistry, leading to many available complexes. In addition, PGMs feature a wide variety of important applications, including (electro) catalysis, both homo- and heterogenous, antitumor chemistries, jewellery, high temperature technical applications, and the nuclear industry.

This symposium will cover advances in the PGM physical chemistry, molecular compounds, metals and alloys that include at least one PGM and novel synthesis methods or materials. Contributions are welcome in, but not limited to, the following areas:

- Physical chemistry of PGMs
- Molecular compounds, complexes of PGMs and their applications
- Electro- and electroless deposition of metals and alloys including PGMs
- Alloys for jewellery and tailoring of optical and mechanical properties
- Catalysis in automotive applications
- Operation of PGMs at high temperature or under extreme conditions

#### Symposium Organizers

Cobus Kriek (Coordinator), North-West University (Cobus.Kriek@nwu.ac.za) Stanko Brankovic, University of Houston Jessica Chamier, University of Cape Town Angel Cuesta Ciscar, University of Aberdeen Gary Patrick, Johannesburg

# (SE)

### Symposium 10

New Concepts and Opportunities in Electrochemical Synthesis: Fundamentals, Methods and Applications

Sponsored by: Division 4, Electrochemical Materials Science

Electrochemical synthesis processes continue to provide significant scientific advances: self-limiting electrodeposition processes are now able to deposit monoatomic layers, under potential or galvanic replacement methods may form atomic to nm-scale coatings conformally on surfaces with arbitrary geometry, and super conformal chemistry succeed in filling trench and nanotubes with high aspect ratio from nm to mm scales. Anodic processes at the same time have the ability to form very thin film dielectrics as well as a wide range of metal oxide nanostructures on any refractory metal and many semiconductors. Media for implementing electrochemical processes have also multiplied: new ionic liquids continue to appear in the literature as well as in the markets, and exotic systems such as supercritical CO<sub>2</sub> or plasmas are now utilized to grow materials that cannot be otherwise obtained. This symposium will show the current state of electrochemical synthesis engineering science and practice, novel synthetic method and new materials as well as innovative methodologies, and will hopefully suggest a way forward. Contributions in all the areas of electrochemical synthesis are welcome, including:

- Self-limiting electrodeposition
- Various flavors of under potential co-deposition, surface-limited replacement, on surfaces or nanos-tructures
- Advances, successes and drawbacks in super conformal growth
- Methods to control structure and properties: voltage/ current waveforms and external fields
- Electrodeposition of alloys
- Synthesis in unusual/exotic media
- Novel methods for atomic/nanoscale control of morphology and function
- De-alloying and its ability to generate tailored porous structures
- Electrochemical anodization at surfaces and generation of nanostructures
- Synthesis of metal oxides, semiconductors and compounds, including 2-D materials
- Novel applications of electrochemically synthesized materials

#### Symposium Organizers

Giovanni Zangari (Coordinator), University of Virginia (gz3e@virginia.edu) Omotayo Arotiba, University of Johannesburg Luca Magagnin, Politecnico di Milano Nolwazi Nombona, University of Pretoria





### The Science, Technology and Engineering of Corrosion

Sponsored by: Division 4, Electrochemical Materials Science

This symposium will cover all aspects of corrosion, from fundamental science through modeling at various length and time scales, to applications such as corrosion protection, with particular emphasis on corrosion control in industry and infrastructure. Papers dealing with corrosion and corrosion protection of water systems, chemical, mining and mineral industry will be particularly welcome.

Topics include but are not limited to:

- Corrosion mechanisms, methods, modelling and monitoring
- New environmentally friendly surface treatments for corrosion protection
- Growth and characterization of chemically/ electrochemically formed surface films
- Environmental degradation of surface-modified materials
- Modelling of structure/properties/performance correlations for surface-treated materials
- In situ and ex situ characterization of surfaces: enabling deep understanding of the processes of surface treatments and corrosion at micro- and nanoresolution.
- Corrosion of steel in concrete
- Corrosion and corrosion protection of drinking water systems, mining and mineral industry, nuclear and chemical industry;
- Corrosion of archaeological and historical artefacts;
- Corrosion of biomaterials.

#### Symposium Organizers

Monica Santamaria (Coordinator) Universita di Palermo (monica.santamaria@unipa.it)

Esther Akinlabi, University of Johannesburg Emeka Oguzie, Federal University of Technology Owerri Sannakaisa Virtanen, University of Erlangen-Nuremberg Vincent Vivier, University Pierre et Marie Curie

### Symposium 12

Electrochemical Technology for Water and the Environment for Social, Health and Economic Development

#### Sponsored by:

Division 4, Electrochemical Materials Science Division 5, Electrochemical Process Engineering and Technology

Water supply and recycling, and soil and natural water system protection are becoming important issues in most countries around the world. Although tools to remediate problems and the circumstances may widely differ. New concepts about the circular economy are key components to understand and support the way of thinking of developed countries, in which sustainability is becoming the key paradigm. Meanwhile, developing countries are focusing on solving the social impact of the unsolved environmental problems of their population. In particular, it is paramount to provide safe water to the population and to avoid health problems associated with polluted environments. An array of electrochemical technologies and processes can help to face both contexts, with new greener and safer technologies. Development and advances of new technological approaches, novel reactor constructions, clarification of electrochemical mechanisms, new electrode materials and mathematical modeling may strengthen this strategy. This symposium aims to be a meeting point between environmental and electrochemical technologists, together with researchers in sustainable water working in disparate regions all around the World. The symposium will also attempt to obtain consensus about best practices in implementing new electrochemical technologies to solve the most serious water supply and environmental problems that humankind has to face in the near future.

#### Symposium Organizers

Manuel A. Rodrigo (Coordinator), Universidad de Castilla-la-Mancha (Manuel.Rodrigo@uclm.es) Henry Bergmann, Anhalt University Ioannis Ieropoulos, University of the West of England Chi-Chang Hu, National Tsing Hua University Heidi Richards, University of the Witwatersrand



### Electrografting of Materials: from Fundamentals to Applications

Sponsored by: Division 4, Electrochemical Materials Science Division 6, Molecular Electrochemistry

This Symposium will cover all aspects of surface modification of materials with organic moieties by their electrochemical activation. The Symposium will cover a broad range of topics, from fundamentals to applications, including but not limited to: electrografting of organic layers on carbon-based and other highly porous materials surfaces as well as platinum group, noble and coinage metals as massive electrodes, films or nano objects, semiconductors and polymers; mechanistic investigations; modelization / synthesis / characterization of molecular supramolecular electrografted architectures; and applications of modified surfaces (in biology, sensors, micro/nanoelectronics, plasmonics, electrochromic devices, electrochemical energy conversion and storage, amongst others). The purpose of this Symposium is thus to bring together leading scientists working on all these aspects, in order to stimulate intensive discussions and initiate collaborations in these topics within the electrochemical community.

#### Symposium Organizers

Olivier Buriez (Coordinator), Ecole Normale Superieure, Paris (olivier.buriez@ens.fr) Samuel Chigome, Botswana Institute for Technology Research and Innovation Philippe Hapiot, Université de Rennes Philani Mashazi, Rhodes University Fetah Podvorica, University of Prishtina





Molecular Electrochemistry: from Fundamentals to Applications

# Symposium 15

Computational Electrochemistry and Simulation: from Prediction of Properties to Optimization of Devices

Sponsored by: Division 6, Molecular Electrochemistry

Contemporary molecular electrochemistry involves investigation of molecular transformations initiated by or involving charge transfer steps. This symposium will cover all aspects of fundamental charge transfer processes (including electrosynthetic aspects) in organic, organometallic (with special focus on the noble metal complexes), coordination, supramolecular assemblies and (conducting) polymers with particular focus on their applications (industry, medicine, material science and electronics). This symposium also includes investigations of charge transfer and charge transport phenomena at a single molecular level. Topics will comprise detailed electrochemical investigation of electron and proton transfer processes, bond activation, new approaches towards elucidation of the charge transfer and transport mechanisms between donor and acceptor, case studies of structure-reactivity relationship (steric, conformational, stereogenic-chiral, etc.), effect of the ion-pairing or host-guest interactions, multi-redox and electrocatalytic systems. Contributions developing new methodologies (advanced imaging, in situ spectroscopic and theoretical approaches) for elucidation of the underlying mechanistic principles of molecular transformations involving charge transfer steps are also welcome. The main purpose of this symposium is to bring together leading scientists working on the mechanistic issues of molecular transformations towards desired functionalities and stimulating their discussion with the rest of the electrochemical community.

#### Symposium Organizers

Magdaléna Hromadova (Coordinator), J. Heyrovsky Institute of Physical Chemistry (hromadom@jh-inst.cas.cz) Jeanet Conradie, University of the Free State Shankara Radhakrishnan, University of Pretoria Guobao Xu, Chinese Academy of Sciences Sponsored by: Division 7, Physical Electrochemistry

Theory and computational electrochemistry give the promise of achieving both a greater fundamental understanding or characterization of experiments and a prediction of the properties and performance of new electrochemical devices prior to experimentation. Based on the advantage of limited cost, they aim to foster the innovation like both fundamental and technology breakthroughs. This symposium aims at coupling aspects of physical electrochemistry to elements of electrochemical engineering, in particular through the use of simulation techniques in strong connection with experimental characterization for validation.

The following topics will be considered:

- Using simulation techniques such as ab initio calculations, molecular dynamics, dissipative particle dynamics, kinetic Monte Carlo, Continuum Fluid Dynamics, multiphysics and/or multiscale computational approaches for understanding and for the optimization and design of electrochemical cells
- Design of experimental validation techniques
- Methods for determination or estimation of parameters entering the computational models
- Comparison and correlation of behaviors and properties obtained at various scales and using different computational techniques
- Applications include: charge transfer processes, electrochemical interfaces, electrocatalysis, porous electrodes, photo-electrochemical cells, electrochemical cells for energy storage and conversion (batteries, supercapacitors, fuel cells, electrolyzers)

#### Symposium Organizers

Alejandro Franco (Coordinator),

Université de Picardie Jules Verne (alejandro.franco@u-picardie.fr) Krishna Bisetty, Durban University of Technology Alex Quandt, University of the Witwatersrand



Spectroscopy, Microscopy and Theory for the Rational Design of Electrochemical Interfaces

#### Sponsored by: Division 7, Physical Electrochemistry

defines The electrode-electrolyte interface the performance of diverse electrochemical devices with applications related to energy (conversion, production and storage), water (purification and remediation), (bio-)chemical sensing, environmental and process monitoring, surface protection, optical displays and electronics. Fabrication of optimized interfacial architecture and functionality for a given application requires the ability to control and determine interfacial composition and the interactions between the system components at a molecular level. Recent advances that combine electrochemical methods with in situ/ in operando spectroscopy, electrochemical scanning probe microscopy, synchrotron-based techniques and theoretical calculations provide a detailed picture of the electrochemical interface at the atomic and molecular

level. These lead to an understanding of the structurereactivity and structure-selectivity relationships that dictate electrochemical reaction mechanisms and kinetics. These are crucial to the design and exploitation of improved materials. This symposium will cover recent developments in experimental and theoretical methods for the understanding and rational design of electrode surfaces, from model electrodes to novel nanostructured electrocatalysts and functional materials.

#### Symposium Organizers

Shaowei Chen (Coordinator), University of California at Santa Cruz (shaowei@ucsc.edu) Dave Billing, University of the Witwatersrand Charl J. Jafta, Oak Ridge National Laboratory Katharina Krischer, Technische Universität München Manuela Rueda, Universidad de Sevilla Bin Ren, Xiamen University





### Electrochemical Technologies for Sustainable and Advanced Manufacturing

#### Sponsored by:

Division 4, Electrochemical Materials Science Division 5, Electrochemical Process Engineering and Technology

Current chemical industrial production methods have approached their practical performance limits, therefore, new transformational, disruptive, and enabling technologies are needed that will provide solutions to the chemical industry beyond incremental manufacturing improvements.

Electrochemistry and electrochemical technologies provide the potential to develop transformational technologies to make more efficient traditional chemical and biological processes. 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.

Topics of interest include, but are not limited to:

- new electrochemical technologies for process water (treatment, reuse), materials synthesis and/or recycling
- sustainable advanced electrode materials and structures;
- life-cycle analysis demonstrating the impact of electrochemistry in sustainable manufacturing,
- advanced cell and system design, including reactant and product flow, heat transfer, and stack level materials corrosion:
- electrochemical performance and cell characterization;
- modeling and simulation of electrochemical phenomena and processes;
- applications and economic analysis;
- scale-up demonstration of novel electrochemical processes.

#### Symposium Organizers

Gerardine Botte (Co-ordinator), Ohio University (botte@ohio.edu)

Takayuki Homma, Waseda University Peter Olubambi , University of Johannesburg Herman Potgieter, University of the Witwatersrand Dongping Zhan, Xiamen University

# Symposium 18

Electrochemistry and Mining: Minerals and Metal Processing

#### Sponsored by:

Division 4, Electrochemical Materials Science Division 5, Electrochemical Process Engineering and Technology

Electrochemistry underpins the separation and recovery of metals, being via high temperature electrometallurgy for smelting (e.g. molten salts for reactive metals like Al or Mg, or slags electrolysis such as in electric arc furnace or novel electrolytes) or electrowinning in aqueous media (e.g. electrowinning of Zn, Cu, or electro-refining) or electrorefining (e.g. Platinum group and precious metals). As a matter of fact all metals go through an electrochemical process in their supply chain - with the exception of iron -, enabling higher purity products and enhanced sustainability. Challenges to further mitigate the environmental impact of materials processing with electrochemistry require advanced understanding of the underlying thermochemistry, electrochemical mechanisms, and transport phenomena along with the development of novel electrolytes, electrode materials or electrochemical configurations. In this context the present symposium seeks contributions that present new results in topics encompassing:

- cathode phenomena (both high and low temperature), including role of impurities, fundamentals of metal deposition in solid and liquid state, novel process evolving gaseous or powder products;
- electrolyte transport properties and physical chemistry;
- anode: inert anode materials development, role of gas evolution on process performance, novel design;
- cell design: modeling, scale-up;
- energy efficiency: process model, trends in a given industry, new frontiers.

#### Symposium Organizers

Antoine Allanore (Coordinator), Massachusetts Institute of Technology (allanore@mit.edu) Bouzek Karel, University of Chemistry and Technology Prague Jochen Petersen, University of Cape Town Yasuhiro Fukunaka, Waseda University Toru Okabe, University of Tokyo



Imaging Heterogeneous Electrochemical Processes: From Single Molecules and Nanoparticles to Vesicles and Cells

Sponsored by: Division 1, Analytical Electrochemistry Division 2, Bioelectrochemistry

Most electrochemical processes are heterogeneous, thus requiring spatially resolved techniques. To address this need, various electrochemically-controlled microscopies, including scanning probe microscopies (e.g., STM, AFM, SECM, SICM) and optical microscopies (Fluorescence, Raman, dark-field, ECL and plasmonics), have been developed in recent years, allowing mapping of local electrochemical activities on electrodes with single molecule and single nanoparticle detection capability. Examples include 1) heterogeneous electrode processes (fingerprints, and electrode and bipolar electrode arrays), and 2) single molecules, nanoparticles, vesicles, and cells. This symposium will focus on how imaging tools address challenges in basic and applied electrochemistry.

#### Symposium Organizers

Nongjian Tao (Coordinator), Arizona State University (nongjian.tao@asu.edu) Aziz Amine, Hassan II University of Casablanca Ismael Diez-Perez, King's College London Wei Wang, Nanjing University

# Symposium 20

Carbon – A Starring Role in Electrochemistry

Sponsored by: Division 4, Electrochemical Materials Science

Carbon-based materials have been successfully employed as electrode materials for the last 70 years, starting from graphite, glassy carbon and carbon paste, ending at the turn of the century to fullerenes (and alike), carbon nanotubes and graphene.

Several applications benefited from carbon-based materials resulting in considerable economical/environmental impact. The symposium is aimed at addressing new perspectives in the use and application of carbon based materials in three main themes: Energy storage; Sensors and Organic/environmental applications. Emphasis will be devoted to the design of electrode materials, taking into account the modifications to the carbon-based material and its inter-relation with performance.

#### Symposium Organizers

Ahmed Galal (Coordinator), Cairo University (galal@sci.cu.edu.eg) Patrick Ndungu, University of Johannesburg Vincent Nyamori, University of KwaZulu Natal Zikhona Tetana, University of the Witwatersrand



#### Flight routes to Johannesburg/Durban Hourly flights from Johannesburg to Durban: duration 40 min.



### General Session

Sponsored by: All Divisions

This Symposium will cover all ISE areas not included in topical symposia.

#### Symposium Organizers

Bernard Tribollet (Coordinator), University Pierre et Marie Curie (bernard.tribollet@upmc.fr) Paul Ejikeme, University of Nigeria Chi-Chang Hu, National Tsing Hua University Samson Khene, Rhodes University Duduzile Nkosi, University of Johannesburg

### Satellite Meetings in South Africa

Energy Storage and Industry 4.0: Challenges and Prospects

31 July – 2 August 2019 KwaMaritane, Pilanesberg National Park

# 5th International Symposium on Electrochemistry

Electrochemistry at Nanostructured Interfaces 11-14 August 2019 Cape Town





# 70<sup>th</sup> Annual Meeting

of the International Society of Electrochemistry 4 - 9 August 2019 Durban, South Africa



### Call for Papers

Authors are invited to submit a one page abstract in English, including figures, tables and references. Abstracts must be submitted online through the ISE website (http://annual70.ise-online.org).

The site will open for submission of abstracts on 15 December 2018. The closing date for submission of abstracts will be 25 February 2019. For details please refer to the ISE website.

### Electrochimica Acta

A special issue of the Society's journal, Electrochimica Acta, is planned based on selected original contributions made at the conference. Selection will be made by an international Editorial Committee comprising a Guest Editor for each Symposium, appointed and co-ordinated by the Special Issues Editor, Sergio Trasatti.

# General Information

#### Venue

Opened by former president Nelson Mandela in 1997, the Durban ICC was South Africa's first International Convention Centre and has played a pioneering role in attracting international events to its shores since its inception.

This world-class facility, renowned for its high standards of service excellence, has successfully staged some of the world's most prestigious and complex events. This multiaward winning Centre has been voted "Africa's Leading Meetings and Conference Centre" by the World Travel Awards no fewer than 15 times since 2001 and has been rated amongst the World's Top 15 convention centres by The International Association of Congress Centres (AIPC). The Durban ICC offers the largest flat floor, column-free multipurpose event space in Africa. Incorporating the Durban ICC Arena and Durban Exhibition Centre, the complex offers 112,000 m<sup>2</sup> of flexible exhibition and meeting space. The Durban ICC delivers a world-class events experience, that exceeds clients' expectations in an innovative, sustainable and proudly African way. Little wonder then, that the Durban ICC is recognised as Africa's leading convention centre.

#### Important Dates and Deadlines

Opening for abstract submission: 15 December 2018 Deadline for abstract submission: **20 March 2019** Conference begins: 4 August 2019

#### Accommodation

Durban offers a wide range of accommodation from beachfront hotels to themed lodges, guesthouses, selfcatering apartments and homely Bed and Breakfast).

#### Climate

Durban has a subtropical climate and easily averages about 320 days of sunshine a year. In August the temperature is generally warm and dry with minimum/ maximum average temperatures of  $13^{\circ}C/23^{\circ}C$  (55° F/73°F).

#### Travel

Most international and domestic travels to and in South Africa are undertaken through the O.R. Tambo International Airport (ORTIA), Johannesburg. ORTIA operates non-stop flights to all six continents, except Antarctica. A number of major airlines operate from ORTIA. King Shaka International Airport is the key airport that serves Durban. It is located in La Mercy, KwaZulu-Natal, which is about 35 km (22 miles) north of Durban city centre. A domestic flight between Johannesburg and Durban takes about 40 minutes. Buses are also operated from Tambo International Airport to Durban twice a day for very reasonable rates.



http://annual70.ise-online.org e-mail: events@ise-online.org