ISE 2018 Annual Report

ISE Division 4 – Electrochemical Material Science

1. Division Officers

Chair: Giovanni Zangari (gz3e@virginia.edu), U. of Virginia
Past Chair: S. R. Brankovic (SRBranko@uh.edu), U. of Houston
Chair Elect: Monica Santamaria (monica.santamaria@unipa.it), Universita' di Palermo
Vice Chairs: Chi-Chang Hu, National Tsing-Hua University, Taiwan
Mikhail Vorotyntsev, M.V. Lomonosov Moscow State University

Activities of Division 4 in 2018
2. Organization and co-organization of symposia at the annual ISE meeting

69th ISE Annual Meeting, 2 – 7 September, Bologna, Emilia Romagna, ITALY (2018)
Division 4 has organized and sponsored exclusively 2 symposia (S 11, 12), and co- sponsored five additional symposia (S 4, 7, 10, 13, 21).

Division 4 has sponsored student poster awards in each of the symposia.

S4 Bipolar Electrochemistry, from Bioanalysis to Materials Science

Sponsored by: Divisions 1, 2, 4

The concept of bipolar electrochemistry has been known for several decades. However, with the advent of micro- and nanotechnology there is considerable renewed interest in this approach as it has become apparent that there are extremely attractive features of bipolar electrochemistry for completely new applications in areas ranging from analytical chemistry to materials science. The renaissance of this topic over the last ten years includes, among others, studies about:

- Electrochemical (bio)sensors and their arrays
- High throughput screening of electrocatalysts
- Controlled generation of surface gradients
- Synthesis of asymmetric particles
- Wireless generation of electrochemiluminescence
- Unconventional motion of small objects
- Photoelectrochemistry
- Corrosion studies

The symposium aims at giving an overview of the potential use of bipolar electrochemistry in very different areas and presenting directions for future evolution.

Symposium Organizers
Alexander Kuhn (Coordinator), University Bordeaux 1, France (alexander.kuhn@enscbp.fr)
Fredrik Björefors, Uppsala University, Sweden
Richard Crooks, University of Texas at Austin, USA
Paolo Ugo, University of Venice, Italy

S7 Electrochemical Systems for Energy Conversion: Fuel Cells and Electrolysers

Sponsored by: Divisions 1, 3, 4

This Symposium includes but is not limited to fundamental and applied studies on functional materials and cell components (e.g., electrocatalysts, ionomers, electrolyte membranes/separators, gas diffusion layers, bipolar plates, etc.); characterization methods and modelling studies for all the different types of fuel cells and electrolysers.

Contributions on the co-electrolysis of CO2 and water to produce sustainable fuels are also welcome. This symposium covers studies on fuel cells, electrolysis and co-electrolysis devices for both low- and high-temperature applications.

A summary of specific topics is reported in the following:

- Synthesis and characterisation of functional materials and cell components for fuel cells and water electrolysis systems for low- and high-temperature applications
- Novel electrocatalysts for oxygen reduction, electro-oxidation of hydrogen and organic fuels, oxygen evolution, and hydrogen evolution
- Electrolyte membrane/separators and ionomers for fuel cells, water electrolysis systems, and CO2/water co-electrolysis systems: 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 electrolyser components in low- and high-temperature applications
- Operando diagnostics/in situ characterization of fuel cells, water electrolysis systems, and CO2/water co-electrolysis systems
- Theoretical studies and computational modeling of functional materials and cell components (e.g., electrocatalysts, ionomers, electrolyte membranes/separators, gas diffusion layers, bipolar plates, etc.)

Symposium Organizers

Vito Di Noto (Coordinator), University of Padova, Italy (vito.dinoto@unipd.it)
Antonino Aricò, ITAE CNR Messina, Italy
Deborah Jones, University of Montpellier 2, France
Hiroyuki Uchida, University of Yamanashi, Japan

S10 **Materials for and from Electrochemistry: State of the Art and Future Trends**

Sponsored by: Division 4, 6

Electrochemically synthesized and electroactive materials both owe their usefulness to the ability to harness redox processes, aimed however at different purposes: synthesis and functionality, respectively. Concepts and phenomena from one could thus be applied to the other, leading to potential synergies and novel insights: think for example of ion intercalation to generate new materials, or inducing functionality by accurately placing active sites. This symposium will cover the latest findings in the electrochemical synthesis of materials, the current status of electroactive materials, and examine the potential synergies derived by exploiting concepts from either. Contributions are welcome in, but not limited to, the following areas:

- New concepts in electrochemical synthesis and electrochemical surface treatment
- Next generation materials by electro-, electroless deposition, and electrochemical surface treatments
- Novel methods for atomic/nanoscale control of morphology and function
- Molecular understanding of additives
- Molecular, supramolecular and electrochemically active materials
- Conjugated and redox-active polymers
- Composite electroactive materials
- Nanostructured and functionalized surfaces
- Carbon nanostructures, e.g. carbon nanotubes, fullerenes and graphene, as well as other 2-dimensional materials such as black phosphorus or dichalcogenides

Symposium Organizers
Giovanni Zangari (Coordinator), University of Virginia, USA (gz3e@virginia.edu)
Sandro Cattarin, ICMATE CNR Padova, Italy
Silvia Franz, Politechnic of Milan, Italy
Massimo Innocenti, University of Florence, Italy
Mikhail A. Vorotyntsev, Mendeleev University of Chemical Technology, Russia

S11 **Corrosion, Passivation, and Protection Strategies**

Sponsored by: Division 4
The symposium will cover all aspects of corrosion science and engineering, such as corrosion mechanisms of advanced materials, corrosion processes in harsh and complex environments, passivity and oxide films, localized corrosion mechanisms, corrosion protection by coatings and inhibitors, as well as corrosion and protection in engineering applications. Contributions dealing with theoretical analysis, novel and exploratory electrochemical techniques to study corrosion phenomena, as well as surface analytical investigations on passive films and corrosion product layers are of interest. Research conducted at different length- and time-scales, in order to enhance understanding of corrosion from nanoscale initiation of localized attack to prediction of engineering failures, are most welcome.

Symposium Organizers
Sannakaisa Virtanen (Coordinator), University of Erlangen-Nuremberg, Germany (virtanen@ww.uni-erlangen.de)
Flavio Deflorian, University of Trento, Italy
Shinji Fujimoto, Osaka University, Japan
Philippe Marcus, ENSCP, France
Monica Santamaria, University of Palermo, Italy

S12 **Electrophoretic Deposition of Functional Coatings: from Materials Science to Biotechnology**

Sponsored by: Division 4
The symposium is focused on the fundamentals and applications of the electrophoretic deposition (EPD) technique with emphasis on Direct Electrically-Driven Assembly processes for the development of coatings and functional films involving advanced particle assembly
and packing strategies. The symposium will cover fundamentals and applications of electrophoretically deposited thick and thin films in several areas such as protective coatings, biomedicine, manufacturing of electro/photoactive, electro-mechanic and optical devices.

Topics will include the fabrication of tailored coatings, films and multilayer structures with new functionalities in:
- Transportation and Communication
- Energy Conversion and Storage
- Health Care and Clean Technologies

In addition, contributions that address the in situ characterization of particle surface modification in liquid media, rheology, deposition ordering and kinetics will be considered, and papers which discuss mechanistic aspects of co-deposition will be particularly welcome.

Symposium Organizers
Aldo R. Boccaccini (Coordinator), University of Erlangen-Nuremberg, Germany (aldo.boccaccini@fau.de)
Begoña Ferrari, CSIS Madrid, Spain
Carmen Galassi, ISTEC CNR Faenza, Italy

S13 **Electrochemistry Applied to Cultural Heritage**

Sponsored by: Division 1, 4, 6

The physical part of the worldwide cultural heritage is deteriorating faster than it is being conserved, restored or studied. Assets are being lost, or are at risk, through natural processes of decay, environmental disasters, the direct effects of enhanced public access, lack of knowledge in conservation/preservation, and simple negligence. The conservation of cultural heritage is for these reasons both a culturally important activity in its own right and an economic need. A multidisciplinary team (i.e. art historians, archaeologists, curators, conservators, as well as analytical scientists, and other specialists at a basic research level) must be involved in solving this issue.
There are several applications of electrochemistry in this area: restoration of metallic objects from cultural heritage, the use of electrochemical techniques for authenticity purposes or contribute to the development of simple diagnostic techniques necessary for identifying practical conservation needs. Electrochemistry can be used in conservation science as an analytical approach in order to determine the composition of the materials forming the object and, eventually, the products of chemical alterations, adherence, materials incorporated in prior restorations, etc. or as restorative/conservation methods in order to preserve the original state of the piece and/or incorporate protective materials for ensuring its future conservation. Electroanalytical methods can be used for determining the composition of the environment around the object (atmosphere, waters, soils) in an archeological site and for monitoring the composition of the environment around monuments or objects preserved in museums, stores, etc.
A selection of papers from this symposium will be published in the Journal of Cultural Heritage, after peer review.

Symposium Organizers
Susana C. de Torresi (Coordinator), University of Sao Paulo, Brazil (storresi@iq.usp.br)
Christopher Brett, University of Coimbra, Portugal
Cristina Chiavari, University of Bologna, Italy
Kurt Kalcher, University of Graz, Austria
Ligia Moretto, University of Venice, Italy

S 21 **General Session**

Sponsored by: All Divisions

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

Symposium Organizers
Bernard Tribollet (Coordinator), LISE CNRS Paris, France, (bernard.tribollet@upmc.fr)
Daniel Belanger, Université du Quebec Montreal, Canada
Hua Cui, University of Science and Technology Hefei, China

3. Topical Meetings

22nd ISE Topical Meeting, Tokyo, Japan, April 15-18 2018.

Division 4 and Division 5 are co-organized and co-sponsored the 22nd ISE Topical Meeting "Materials Engineering and Process Optimization at Electrified Solid/Liquid Interfaces"
Co-organizers proposed by Division 4 include

Hu, Chi-Chang, National Tsing-Hua University, Taiwan
Zangari, Giovanni, U. of Virginia, USA

24th ISE Topical Meeting, Merida, Mexico, April 7-10, 2019

Division 4 and Division 6 are co-organized and co-sponsored the 24th ISE Topical Meeting "Electrochemical assembling at the meso, nano and molecular scale"

Co-organizers proposed by Division 4 include Brankovic, Stanko, U. of Houston, USA
Breugelmans, Tom, U. of Antwerp, Belgium

4. Sponsored Meetings

Division 4 sponsored the following meetings in 2019
2nd Nucleation and growth research conference, June 10-13, 2019, Kyoto, Japan

Division 4 approved a sponsoring request for the "6th international conference on advanced capacitors, ICA 2019", to be held on August 8-12 2019, in Ueda, Japan

Division 4 will approve a sponsoring request for the "Advanced batteries, accumulators, and fuel cells, ABAF-20, to be held on August 25-28, 2019 in Brno, Czech Republic

Division 4 will approve a sponsoring request for the "21st YUCORR International Conference" to be held on 17-20 September 2019 in Tara Mountain, Serbia.

Division 4 will approve a sponsoring request for the "Advanced electrochemical oxidation for water reuse" to be held on 31 March – 2 April 2020 in Nancy, France

5. Division Poster Awards

Poster Awards are planned for the 70th ISE Annual Meeting in Durban. One poster award per each sponsored symposium will be provided. The poster award provides for USD 300 plus a ticket for the meeting dinner.
The Division is also planning for prospective poster awards at future topical meetings.

6. Chaired and sponsored ISE prizes

*ISE-Prize for Electrochemical Material Science (Total **1000** Euro)*
The prize is awarded annually to a young electrochemist on the basis of published work in the field of corrosion, electrodeposition or surface treatment.
Recipient for 2018: Dr. Peng Bai, Eashington University in St. Louis
ISE Elsevier Prize for Applied Electrochemistry
The Chair of Division 4 was in the selection committee for the above ISE Prize.

7. Contribution to *Electrochimica Acta* Special Issues

In the context of the 69th Annual Meeting, Division 4 will contribute to the Electrochimica Acta Special Issue with the following guest editors:
Symposium 4: Alexander Kuhn
Symposium 10: Giovanni Zangari
Symposium 11: Sannakaisa Virtanen
Symposium 12: Aldo Boccaccini