Report on Division 3 Activities from August 2020 to September 2021

There are currently 1787 active members of Division 3 from Europe, Asia, North and South Americas, Africa and Oceania. Division 3 is the second largest Division after Division 4 in the International Society of Electrochemistry (total 3242 members).

1) Division Officers 2021-2022 term:

Since 01/2021

Chair: Andrea Balducci (Friedrich Schiller University Jena, Germany)
Past Chair: Francesca Soavi (University of Bologna, Italy)
Chair Elect: Thierry Brousse (University of Nantes, France)
Vice- Chairs: Sonia Dsoke (KIT, Germany), Wataru Sugimoto (Shinshu University, Japan)

2) Annual meeting

D3 sponsored symposia of *72nd* ISE Annual Meetings "Electrochemistry from Fundamentals to Products" - *Jeju Island, Korea (29 August-3 September 2021)*

Symposium 6 - Advanced lithium-ion batteries; from basics to cutting-edge technologies (D3)
Organizers: *S.-W. Song (Coordinator, Korea), K. Y. Chung (Korea), C. Masquelier* (France), *Gu Lin (China), H. Sakaebe (Japan), D. Bresser (Germany)*

Lithium-ion batteries are ubiquitous power sources for a variety of applications ranged from consumer electronics to electric vehicles and grid-based energy storage systems. Battery energy density and performance depend critically on the materials used, so the development of new materials and a fundamental understanding of electrochemical phenomena are important for advancing battery technology. The symposium is devoted to the discussion on both fundamental and applied aspects of the advances made in lithium-ion batteries, from the design of new electrode materials, electrolytes, interfaces and mechanism analyses to the improvement in performance, cycle life and safety.

Symposium 7 - Next-generation Batteries: Novel chemistry and design (D3)
Organizers: S. Bodoardo (Coordinator, Itay), *J. Chacón (Spain), A. Varzi (Germany), K. Kang (Korea), Y. M. Lee (Korea), J. Suk (Korea)*

The expected growing demand for next-generation electrical energy storage systems that have higher energy density, safey and lifetime, the search for next- generation batteries are driving the research towards identifying new electrochemical systems capable to store huge quantities of energy. Moreover, wearables, medical and environmental sensors and other applications require new features and battery designs that traditional battery technologies cannot provide. Post Li-ion systems -such as Li-S, Li-air, all-solid-state batteries, Na-ion and redox flow batteries etc.- and flexible, thin and/or printed batteries can be the promising

cadidates satisfying these demands. This symposium is therefore devoted to recent progress in the fundamental and applied aspects of post-LIB systems from the design of next-generation electrode materials, electrolytes, interfaces and cell shape/configurations to the improvement in performance of batteries.

Symposium 8 - Challenges in Battery Technologies for Advanced and Next-generation Electric Vehicles and Grid Storage (D3)

Organizers: Y.-G. Lee (coordinator, Korea), J. Y. Kim (Korea), K. Zaghib (Canada)

This symposium will focus on advances in medium and large-sized lithium rechargeable batteries for electric vehicles(EVs) and energy storage system(ESS) commercialized by cell makers. The symposium is designed to be invitation only mainly for companies. The symposium deals with how to design batteries for EVs and ESS respectively and what major factors should be considered from materials to cell design. In addition, this symposium aims to address battery management and cooling systems including battery safety issues as well as module and pack design. The symposium aims to overview both the state of the art development and research progress in the EVs and ESS batteries.

Symposium 9 - Electrochemical capacitors, capacitive and pseudocapacitive materials, hybrid devices, high power (D3)

Organizers: A. Balducci (Coordinator, Germany), S. Dsoke (Germany) , W. Sugimoto (Japan) , W. Kim (Korea), H.S. Paark (Korea)

This symposium will be dedicated to the most recent investigations related to fast storages processes and their use in real-world application. The goal of this symposium is to address several aspects related to these processes including: (1) capacitive materials; (2) pseudocapacitive materials; (3) practical electrochemical systems components, including current collectors, binders and separator (4) novel characterization methods for storage electrochemical processes; (5) development and investigation of new device designs (symmetric and asymmetric), (6) theory and modeling.

Symposium 10 - Electrochemical systems for energy conversion: Fuel Cells and Electrolyzers (D3)

Organizers: F. Jaouen (Coordinator,France), M. Shao (China), C. H. Choi (Korea), S. H. Joo (Korea)

This symposium will cover both fundamental and applied studies ranging from novel functional materials to complete cells and stacks for energy conversion within fuel cells and electrolysers. Specific topics are as follows:

- *Novel electrocatalysts for CO2 electroreduction and hydrogen evolution*
- *Novel electrocatalysts for hydrogen and fuel oxidation*
- *Novel electrocatalysts for oxygen reduction and oxygen evolution*
- *Durability studies of electrocatalysts*
- *Novel polymer electrolyte membranes and ionomers*
- *Novel ceramic and solid oxide separators*
- *Durability studies of low and high temperature fuel cells and electrolysers*
- *Post mortem and operando techniques for improved understanding of cell degradation*

- *Catalysts free of platinum-group-metals for oxygen reduction*
- *Catalysts free of platinum-group-metals for hydrogen oxidation*
- *Computational modelling of the performance and durability of complete cells*

Symposium 11 - Electrochemical Conversion of Carbon Dioxide and its Utilization (D3)
Organizers: Y. Kwon (Coordinator, Korea), Y.J. Hwang (Korea), C. Hahn (USA), B. S. Yeo (Singapore), R. Kortlever (Netherlands)

This symposium will focus on the recent advances in electrochemical Carbon Dioxide (CO2) conversion from fundamental understanding to industrial application toward producing valuable fuels and chemicals. It covers the topics of CO2 reduction catalysts, electrolyzers, in-situ techniques, theoretical and experimental approaches, and the scale-up technologies, as well as beyond CO2 chemistry.

Symposium 13 - Advanced Processes for Materials Recycling: from Batteries to E-Waste (D5, D3, D4)
Organizers: G. Botte (coordinator, USA), C. Santato (Canada), F. La Mantia (Germany), I.-C. Jang (Korea), Y. Kim (Korea)

The demand for batteries continues to grow including applications such as electric vehicles and electronics devices. The proper disposal of these batteries and the recycling and reutilization of materials is a critical need. Furthermore, metals such as Ni, Co, Cr, Ag, Au, Fe, Cu, Zn, and V are widely used as based catalysts for multiple applications, including: oil refining, batteries, chemical processes, air emissions control, etc. During such processes, these catalysts will degrade over time, losing their catalytic utility and eventually become waste. In the electronics industry especially, these metals represent a significant portion of the waste from deprecated board circuits. The production of such wastes (spent catalysts, batteries, and board circuits) has become one of the major environmental concerns in these industries, mainly due to their toxicity and metal emissions.

Symposium 16 - Mathematical modelling in electrochemistry – from molecular scale to the process design (D5, D3, D4, D7)
Organizers: K. Bouzek (coordinator, Czech Republic), F. Lapicque (France), A. Franco (France), J. Fuhrman (Germany), H. Kim (Korea), H. C. Ham (Korea)

Mathematical modelling represents a powerful tool of increasing importance in all domains of research and development, including electrochemistry and related fields. Its role is inevitable in understanding processes occurring on a molecular scale, as well as in analysis of complex experimental data or in design and optimization of electrochemical processes and systems. With increasing power of standard computers accompanied by rapid development of mathematical methods and related software, problems of high complexity can nowadays be solved. This rapid development however, raises a number of new important questions and challenges. Efficient approaches are searched allowing to approach new problems and/or to reduce the number of simplifying assumptions. Reliable mathematical methods are developed able to solve complex models of limited stability. The target of this Symposium is to bring together specialists from fundamental and engineering sciences. This will allow fostering interdisciplinary collaboration and advancement of the novel approaches in the

field of mathematical modelling of electrochemical processes and devices through discussion of experts in the individual fields.

Symposium 23 - Electrochemistry Knowledge transfer: from Academy to Startup Company and Industries (D3, D1-6)

Organizers: F. Soavi (coordinator, Italy), G. Botte (USA), F. Di Franco (Italy), C. H. Lee (Korea), J.H. Shin (Korea)

This symposium will provide an international forum focused on knowledge transfer in electrochemistry and electrochemical engineering. It will highlight how innovation in several fields where electrochemistry plays a key role, from energy storage and conversion, to materials processing and engineering, sensing, water treatment, biomedical devices, and bioelectrochemistry impacts on the economic growth of our society by creating skilled job opportunities from an entrepreneurial point of view. It will also highlight activities related to open innovation and strategic industry/university partnership towards research, development, and commercialization. Topics of interest include, but are not limited to: i) spin off experiences of academic research products from academy, ii) public organisations programs that are supporting knowledge transfer actions, iii) successful cases of established companies funded as spin off, iv) Open Innovation programs and strategic industry/university partnerships, v) funding opportunities by business angel associations and venture capitals.

Symposium 24 - Electrochemistry, Looking Back Looking Forward: Personal Perspectives (All)

Organizers: W. Shin (Coordinator, Korea), T. D. Chung (Korea)

Electrochemistry, dating back to Galvani, Volta, and Faraday, has been evolving over the past two centuries and pervading every region of the globe that includes east asia. Harmonizing with recent technological revolutions, it is getting into a new phase to drive many other related disciplines. Modern electrochemistry is now at the center of human life as well as industry, undoubtedly owing to the immese contribution of numerous electrochemists. Electrochemistry is what electrochemists do. The lives of electrochemists are the history of electrochemistry. This symposium is to share invaluable experiences and achievements of the main figures who have been leading the national and international electrochemical societies. All speakers will be invited to give their experiences in research and education in conjunction with their life stories. This will be homage to the predecessors and also inspiration to the successors for the sustainable future of electrochemistry.

Symposium 25 – General session

Organizers: C.-C. Hu (coordinator, Taiwan), L. J. Hardwick (UK), H. Lee (Korea)

This symposium will cover conceptual aspects, fundamentals, and applications of all ISE areas which are not compatible with the topical symposia. This symposium will provide a forum for researchers and graduate students to present their recent advanced research results of general interests to the ISE meeting attendees. The purpose of this symposium is to foster and promote work in both electrochemical sciences and technologies, and to stimulate researcher and student interests and participation in ISE. A competition for the best poster in electrochemical sciences and technologies will be part of the symposium. A best student prize will be given to the presenting student author on the winning paper.

3) Topical meetings

In 2021, D3 sponsored the following meetings:

- 29th ISE Topical Meeting
  Energy and water: electrochemistry in securing the sustainable society development
  18 - 21 April 2021, Mikulov, Czech Republic

- 30th Topical Meeting
  Electrochemical Deposition for Semiconductor and Green Energy
  21-24 November 2021, Taipei, Taiwan

4) D3 sponsored meetings

ISE Division 3 supports academic events, which are aligned with ISE mission and relevant to Division 3 science and technology areas of interest in electrochemical energy conversion and storage. Financial support is primarily dedicated to the sponsorship of Student Poster Awards.
D3 sponsored the following meetings:

- Post-Lithium research: women in focus
  Date: 27-28 July 2021, Location: Online, Germany
- Advanced Batteries, Accumulators and Fuel Cells
  Date: 22-25 August 2021, Location: Brno, Czech Republic
- Advanced Battery Power Online Conference 2021
  27 - 28 April 2021, Germany
- Italian Virtual Workshop on Fuel Cell 2021 (IVWFC 2021)
  16-19 March 2021,Online Italy (along with Div. 4)
- Italian Workshop on Energy Storage 2021 (Online)
  24 - 26 February 2021, Italy (online),
- Bridging two centuries of electrochemical storage. In honor of Roberto Marassi. (Online)
  4 - 5 February 2021, Camerino, Italy (online)
- I Meeting on Electrochemical Energy Conversion and Storage Devices
  28-29 January 2021, Madrid, Spain,
- #BioFuel20. Bio-hybrid approaches to solar energy conversion: the bio-material interface
  19-23 October 2020, Barcelone, Spain,
- Advanced Batteries, Accumulators and Fuel Cells ABAF-21
  6-9 September 2020,Brno, Czech Republic, (along with Div 4)

5) Division Poster Awards

The Division sponsored Student Poster Awards at the ISE-sponsored listed above

6) Contribution to Electrochimica Acta Special Issues

Electrochimica Acta Special Issue containing selected papers presented at the 72nd ISE Annual Meeting in Jeju, Korea is planned. D3 contribute to this issue with the symposiums indicated above

7) Annual division meeting

The annual meeting of division 3 took place the 23rd September 2021 on-line

Andrea Balducci
(on behalf of ISE Division 3)
28/09/2021