

Report on Division 3 Activities in 2015-2016

There are currently 1620 (up from 1341 in 2014) members of Division 3 in 60 countries worldwide (Europe 46%; Middle and Far East 35.5%; North America 8%; South America 6%; Africa 2.5%; Oceania 2%).

1) Division Officers in 2016

Chair: **Stefano Passerini** (Germany)

Chair Elect: **Robert Kostecki** (USA)

Past Chair: **Deborah Jones** (France)

Vice- Chairs: **Hiroyuki Uchida** (Japan) and **Francesca Soavi** (Italy)

2) Annual Meetings

66th ISE Meeting, October 4 – 9, Taipei, Taiwan

Division 3 sponsored the following symposia:

Symposium 3: Batteries for Tomorrow's World

Organizers:

Robert Kostecki (Coordinator), Lawrence Berkeley National Laboratory, Berkeley, USA

She-Huang Wu (Co-coordinator), Tatung University, Taipei, Taiwan

Kuniaki Tatsumi, National Institute of Advanced Industrial Science and Technology, Osaka, Japan

Fu-Ming Wang, National Taiwan University of Science and Technology, Taipei, Taiwan

The focus of the symposium was to review recent R&D efforts to elucidate fundamental chemical, transport, electrical, and physical processes that can help improve the existing state-of-the-art Li-ion batteries and stimulate development of next generation rechargeable batteries e.g., Li-S, Me-air batteries, Na-ion, redox flow and multi-valent systems etc.

Topics included but were not limited to:

- Advanced materials, electrodes and electrolytes for rechargeable batteries
- Novel rechargeable battery systems
- Interfacial phenomena
- Cell testing, performance evaluation, failure mechanisms
- New computational and characterization tools
- Safety

Symposium 4: Advances in Fuel Cells from Materials to Systems

Organizers:

Hiroyuki Uchida (Coordinator), University of Yamanashi, Kofu, Japan

Lorenz Gubler (Co-coordinator), Paul Scherrer Institute, Villigen, Switzerland

Kuan-Zong Fung, National Cheng Kung University, Tainan City, Taiwan
Kuei-Hsien Chen, Institute of Atomic and Molecular Sciences, Taipei, Taiwan
Yu-Lin Kuo, National Taiwan University of Science and Technology, Taipei, Taiwan

The focus of this symposium was on all types of low and high temperature fuel cells, as well as electrochemical generation of hydrogen. Particular emphasis was given to the *in situ* and operando characterization of fuel cells and electrolyzers, and to recent materials developments for durable fuel cell components, as well as the optimized integration of fuel cells into energy supply systems.

Topics included but were not limited to:

- Synthesis and design of fuel cell materials (catalysts, electrolytes, gas diffusion layer, bipolar plates, etc) and materials for low and high temperature electrolyzers
- New experimental approaches for characterization of fuel cell and electrolyzer materials
- Electrocatalysis for oxygen reduction, and oxidation of hydrogen and organic fuels
- Novel electrolyte materials synthesis, structural and electrochemical characterization
- Improved understanding of electrochemical reaction processes in fuel cells
- New insights into the degradation and aging modes of component materials and failure mechanisms of fuel cells and electrolyzers
- Fuel cell operando diagnostics, in situ characterization

Symposium 5: Novel Insights to Electrochemical Capacitors

Organizers:

Hsi-Sheng Teng (Coordinator), National Cheng Kung University, Tainan City, Taiwan
Chi-Chang Hu (Co-coordinator), National Tsing Hua University, Hsinchu, Taiwan
Elzbieta Frackowiak (Coordinator), Poznan University of Technology, Poznan, Poland
Masashi Ishikawa, Kansai University, Suita, Japan
Frédéric Favier, CNRS University of Montpellier 2, Montpellier, France

This symposium addressed all fundamental and practical aspects on electrochemical capacitor research, development and applications. Topics included capacitor performance for power uses such as electric vehicles and energy storage application as well as advanced materials for capacitors (e.g., carbonaceous materials and their composites, polymers, inorganic materials etc.). Novel insights into capacitors, such as *in situ* study of electrode/electrolyte interfaces, new designs/concepts for fabricating high performance devices, and synthesis of advanced electrolytes were also addressed.

Topics included but were not limited to:

- Double-layer capacitance and pseudocapacitance of porous materials
- Materials with primarily faradaic pseudocapacitance: metal oxides, nitrides, sulfides, and other advanced inorganic materials, and conducting polymers
- Characterization methods for physical structures and fundamental electrochemical processes of new electrode materials and architectures
- Optimization of components: current collectors, electrodes, electrolytes, separators, and packaging
- Design of new devices and hybrid systems combining capacitors and other power sources (e.g., batteries, fuel cells)
- Capacitor modeling for predicting performances of materials and devices
- New electrolytes for capacitors (redox active electrolytes and ionic liquids)
- Aging and corrosion phenomena in capacitors

Symposium 6: New Progress in Electrochemical Solar Cells

Organizers:

Ladislav Kavan (Coordinator), J. Heyrovsky Institute of Physical Chemistry, Prague, Czech Republic

Anders Hagfeldt, Uppsala University, Uppsala, Sweden

Kuo-Chuan Ho, National Taiwan University, Taipei, Taiwan

Jih-Jen Wu, National Cheng Kung University, Tainan City, Taiwan

This symposium focused on the new progresses in the developments of the electrochemical solar cells and includes topics from materials synthesis to devices and the strategies to overcome the current limitations.

Topics included but were not limited to:

- Electrochemical photovoltaic cells
- Photoelectrochemical cells
- Water splitting
- Dye sensitized solar cells
- Electrodes
- Electrolytes
- Nanostructured semiconductors and dyes for light harvesting

Symposium 13: Molecular Systems for Energy Conversion

Co-sponsored with Division 6, Molecular Electrochemistry

Organizers:

Jay Wadhawan (Coordinator), The University of Hull, Hull, UK

Carlos Eduardo Frontana Vazquez, CIDETEQ, Queretaro, Mexico

Nathan Lawrence, Schlumberger Cambridge Research, Cambridge, UK

Bluse Ching-Hsing Chen, National Taiwan University of Science and Technology, Taiwan

This symposium focused on recent development in molecular systems for solar energy conversion devices, including solid-state dye-sensitized solar cells (ss-DSSC), quantum-dot solar cells (QDSC), extremely thin absorber solar cells (ETASC), perovskite solar cells (PSC) and solar fuel cells.

Topics included but were not limited to:

- Design of various molecules for solar-to-fuels conversion
- Design of various dyes for ss-DSSC: organometallic dyes, metal-free organic dyes, porphyrins and so on
- Development of new light absorbers for QDSC and ETASC
- Development of various types of organic hole-transporting materials (HTM) and electron-transporting materials (ETM) for QDSC and PSC: from small molecules to polymers
- Fabrication and characterization of nanostructured metal oxide electrodes: TiO₂, ZnO, Al₂O₃, NiO, MoO₃ and so on
- Structural design for planar heterojunction PSC: from n-type or p-type single-cell devices to tandem devices
- Long-term stability and scale up of lab cells to industrial/ module scale
- Mechanistic aspects of device performance: experimental techniques and theoretical models for the characterization of charge transport, recombination, collection yield and overall efficiency

Symposium 17: Novel in Situ in Operando Methods

Co-sponsored with Division 7, Physical Electrochemistry

Division and New Topics Committee

Organizers:

Hector Abruna (Coordinator), Cornell University, Ithaca, USA

Patrick Unwin, University of Warwick, Coventry, UK

Anthony Kucernak, Imperial College London, London, UK

Michael Eikerling, Simon Fraser University, Burnaby, Canada

Shawn D. Li, National Taiwan University of Science and Technology, Taipei, Taiwan

Ming Chang Yang, National Cheng Kung University, Tainan City, Taiwan

This symposium gathered contributions highlighting recent methodological and topical developments in the field of advanced electrochemical/ electrocatalytic technologies, including fuel cells, batteries, supercapacitors and electrolyzers are recognized to be complex and dynamic on a wide range of lengthscale and timescales. To understand and improve the functioning of such electrodes and electrochemical cells, techniques that are able to monitor processes in-situ or in operando under working conditions were emphasized together with synergies between experimental measurements and modelling.

Topics included but were not limited to:

- Investigation of electrochemical phenomena using in operando methods based on advanced spectroscopic and microscopic techniques
- Novel in-situ methods applied to electrocatalytic systems generally, fuel cells, energy storage systems and other complex electrochemical systems, including S/TEM, NMR, mass spectrometry, Raman microscopy, x-ray absorption spectroscopy and diffraction, XPS and in-situ electrochemical probes, among other techniques

- Studies which highlight materials performance and structural/ morphological changes in operando
- Time- and spatially-resolved measurements of electrocatalytic reactions at and near to electrode surfaces
- Applications which emphasise unusual environments and conditions (e.g. supercritical fluids, extreme temperatures and pressures)

3) Topical Meetings. Division 3 co-organised the 18th Topical Meeting "Oxygen Electrocatalysis in Chemical Energy Conversion and Storage Technologies" 8 – 11 March 2016, Gwangju, South Korea together with Division 7 Physical Electrochemistry and ISE Region South Korea

Organisers:

Naoko Fujiwara, Osaka, Japan

Timo Jacob, Ulm, Germany

Frédéric Jaouen, Montpellier, France

Jaeyoung Lee, Gwangju, South Korea (Chair)

Bongjin Simon Mun, Gwangju, South Korea (Co-Chair)

Yongsug Tak, Incheon, South Korea

Hiroyuki Uchida, Kofu, Japan

The meeting was held at Oryong Hall of Gwangju Institute of Science and Technology in Gwangju, South Korea.

The 214 participants (plus not a few accompanying persons and visitors) came from 22 countries of all around the world and the region of the world with most participants was Asia (72%).

The most recent advances in oxygen electrocatalysis were extensively discussed. During the conference, the researches on noble and non-noble electrocatalysts, operando analysis, catalyst design based on theory, catalyst support, bi-functional catalysts, fuel cells, water electrolysis, metal-air batteries, fuels from CO₂, and electrode architecture were covered.

Highlights of some of the latest advancements were presented in 7 keynote lectures, 19 invited lectures, 43 oral and 103 poster presentations.

4) Sponsored Meetings:

ISE Division 3 formally and/or financially sponsors the events dealing and promoting the various research fields of "Electrochemical Energy Conversion

and Storage”. Financial support is in particular awarded for Students’ Poster Awards thus granting the visibility of ISE.

Division 3 has sponsored the following meetings in 2015 and 2016:

International Symposium on Polymer Electrolytes 15 15-19 August 2016, Uppsala, Sweden

Gordon Research Conference: Fuel Cells 7-12 August 2016, Eaton, MA, USA

Reactivity of nanoparticles for efficient and sustainable energy production –IV 7-12 August 2016, Gilleleje, Denmark

International Meeting on Ionic Liquids for Electrochemical Devices 11-13 July 2016, Rome, Italy

14th International Conference on Electrified Interfaces 3-8 July 2016, Singapore, Singapore

ELectrospinning for ENergy 2016 22-24 June 2016, Montpellier, France

Controlling Lithium Battery Interfaces 27 May 2016, Orlando, Florida, USA

5th International Conference on Advanced Capacitors 23-27 May 2016, Otsu, Japan

32nd PSI Electrochemistry Symposium: Electrolytes - the Underestimated Player in Electrochemical Processes 27 April 201, Villigen PSI, Switzerland

Hydrogen Days 2016 - 8 April 2016, Prague, Czech Republic

International Conference on Capacitive Deionization and Electrosorption 26-29 October 2015, Saarbrücken, Germany

The Inorganic Days, 2015 15-17 June 2015, Visby, Island of Gotland, Sweden

XXIII International Symposium on Bioelectrochemistry and Bioenergetics 14-18 June 2015, Malmö, Sweden

International Symposium on Enhanced Electrochemical Capacitors 8-12 June 2015, Montpellier, France

5th Regional Symposium on Electrochemistry South-East Europe 7-11 June 2015, Hotel Riu-Pravetz - near Sofia, Bulgaria

and will sponsor the following meetings:

International Meeting on Electrochromics 28 August -1 September 2016, Delft, Netherlands

Advanced Batteries, Accumulators and Fuel Cells 28 August 2016, Brno, Czech Republic

International Conference on Advances in Semiconductors and Catalysts for

Photoelectrochemical Fuel Production 5-6 September 2016, Berlin, Germany

European Materials Research Society Fall Meeting 2016 19-22 September 2016, Warsaw, Poland

3rd International Conference on Sodium Batteries 7-9 December 2016, Geelong, Australia

European Materials Research Society Spring Meeting 2017 22-26 May 2017, Strasbourg, France

21st International Conference on Solid State Ionics 18-23 June 2017, Padova, Italy.

- 5) **Get-together/Networking:** Division 3 will hold a luncheon meeting during 67th ISE Meeting in The Hague to inform Division 3 members on the Division

activities. This will be an opportunity for all Division 3 members to discuss various issues.

6) Division Poster Awards

The Division sponsored Student Poster Awards at the **18th Topical Meeting** (9 - 11 March 2016, Gwangju, South Korea) and **ISE Annual Meeting** (21 – 26 August 2016, The Hague, Netherlands) and the several meetings listed above.

7) Scientific Meetings Committee

Francesca Soavi attended the SMC meeting on 1st April 2016 in Lausanne. The information received at the meeting was distributed promptly to the other Division 3 Officers. This meeting was considered particularly useful with a dedicated whole day for exchanges between Division Officers and other ISE Officers and Scientific Meeting organisers. Specifically, the procedure for the nomination of Candidates for Division Elections, the use of the ISE mailing list, the divisional budget and funds, the procedure for the poster prize nomination and of meeting sponsoring, the organisation of 2017 and 2018 Annual ISE Meeting in Providence and Bologna and of future meetings were discussed.

8) Contribution to *Electrochimica Acta* Special Issues

In 2016 Division 3 sponsored symposia (5 through 8, 12 and 18) will contribute to the Special Issue of selected papers presented at the 67th ISE Annual Meeting in The Hague.

Guest editors for the above mentioned symposia are:

Symposium 5: Uwe Schroeder

Symposium 6: Stefano Passerini

Symposium 7: Matthias Arenz

Symposium 8: Wataru Sugimoto

Symposium 12: Deborah Jones

Symposium 18: Deepak Pant

Stefano Passerini
(on behalf of ISE Division 3)
20/08/2016