

## Division 6: Molecular Electrochemistry 2021 Annual Report

### 1. Present status

Molecular Electrochemistry Division has currently **504** active members (September 2021). This represents a small decrease from last year's count of 518 active members.

Division officers: Chair: **Magdaléna Hromadová** (Prague, Czech Republic)

Past Chair: **Patrizia R. Mussini** (Milano, Italy)

Chair Elect: **José H. Zagal** (Santiago, Chile)

ViceChairs: **Guobao Xu** (Changchun, China), **Ismael Díez Pérez** (London, UK)

ISE divisional elections for Chair Elect 2021/2022 took place in October 2020.

### 2. Scientific Activity

#### 2.1. Scientific meetings

Due to a persisting COVID situation two anticipated meetings in 2021 were postponed to year 2022, namely the Frumkin Symposium (<http://frumkinsymp.ru/>), to which our Division has already granted the sponsorship and 33<sup>rd</sup> topical meeting of ISE "Challenges in Molecular Electrochemistry and Surface Reactivity", Santiago, Chile, where our Division serves as a main organizer.

In 2021 our division was involved in the organization of 72<sup>nd</sup> ISE annual meeting in Jeju, South Korea, which took place in a hybrid form. Our division co-organized 7 symposia, out of which 4 represented our main research activities. Due to the COVID situation our Division participated in 3 poster prize awards. Two symposia 19 and 22 decided to combine the eligible student poster presentations to compete for 1 poster prize. Below is an overview of these 4 symposia.

#### **Symposium 17: Molecular Electroanalysis.** (Divisions 1 and 6)

Organizing Committee: coordinator **Patrizia R. Mussini** and **Luigi Falciola** (Università degli Studi di Milano, Italy), **Guobao Xu** (Changchun Institute of Applied Chemistry, China), **Olivier Buriez** (École Normale Supérieure, Paris, France), **Dongil Lee** (Yonsei University, Seoul, Korea), **Jongwon Kim** (Chungbuk National University, Korea)

Molecular electrochemistry and Electroanalysis are reciprocally indissolubly linked and reciprocally provide fundamental support. In fact (i) on one hand the elucidation of electron transfer process mechanisms is the necessary condition for the conscious, straight optimization of new electroanalytical methods and protocols (rather than random or trial-and-error approaches, unfortunately very common), (ii) on the other hand, electroanalytical techniques, also combined with other analytical and/or computational ones, are providing more and more powerful tools for the elucidation of complex electron transfer mechanisms or of electron transfer processes in complex molecules or materials. In this context

the type and extent of information obtainable for electroactive molecules can be remarkably widened. The symposium will thus particularly focus on: electroanalytical tools, techniques and/or protocols for the elucidation of electron transfer processes, particularly in complex molecules and materials: new approaches or application of existing ones to solve complex cases; Electroanalytical tools, techniques and/or protocols, and/or integration with other analytical or computational techniques enabling to extend the range of information obtainable for electroactive molecules and materials; Optimization of electroanalytical methods or protocols on the basis of electron transfer mechanism elucidation *etc.*

The symposium hosted 25 scientific presentations: 3 keynote and 6 invited lectures, 16 regular lectures and 8 posters. 1 poster prize was awarded.

**Symposium 18: Bringing Biomolecules and Electrodes together: Understanding Electron Transport in Life.** (Divisions 6 and 2)

Organizing Committee: coordinator **Ismael Díez-Pérez** (King's College London, UK), **Magdaléna Hromadová** (J. Heyrovský Institute of Physical Chemistry, Czech Republic), **Renata Bilewicz** (University of Warsaw, Poland), **Pau Gorostiza** (Institute for Bioengineering of Catalonia, Spain), **Byung-kwon Kim** (Sookmyung Women's University, Korea), **Yangrae Kim** (Kwangwoon University, Korea)

This symposium will gather scientists working within the rapidly expanding community of BioMolecular Electronics and related fields, who are using electrified interfaces to understand the key ingredients supporting electron transfer/transport in life. The symposium will cover all aspects of electron transport/transfer in molecular or biomolecular moieties where the electrochemical characterization has or could find an essential role. In order to put together researchers with very distinct perspectives of this topic, the symposium will target studies that range from fundamental approaches, including single-molecule or nanoscale electrical platforms and computational modelling, to micro-scale molecular junctions involving hybrid micro/nano-structured materials for device applications. Such wide vision will ensure attracting researchers interested on very different aspects of molecular electron transport, namely, from physical mechanisms and structural aspects of it, to those interested on potential electrical applications such as molecular transistors, (bio)molecular sensors, sequencing platforms, *etc.*

The symposium hosted 20 scientific presentations: 5 keynote and 7 invited lectures, 8 regular lectures and 7 posters. One of the keynote lectures was the J. Heyrovsky prize lecture delivered by Prof. Justin Gooding. 1 poster prize awarded.

**Symposium 19: Physicochemical and Mechanistic Aspects of Organic Electrosynthesis.** (Divisions 7 and 6)

Organizing Committee: coordinator **Shinsuke Inagi** (Tokyo Institute of Technology, Japan), **Shen Ye** (Tohoku University, Japan), **Amanda Garcia** (University of Amsterdam, Netherlands), **Siegfried Waldvogel**, **Jiri Ludvik** (J. Heyrovsky Institute, Czech Republic), **Marilia Goulart**, **Hyun S. Ahn**, **Hai-Chao Xu**

Recently, organic electrosynthesis has been attracting much attention of chemists in various fields, due to its dual nature of sophisticated/simple approach for synthesis including high selectivity with

environmentally benign system. To better design reactions for organic electrosynthesis, deep understanding of physical electrochemical aspects is an important issue. This symposium will cover a broad range of topics including, but not limited to: organic electrosynthesis, organometallic electrochemistry, the role of electrode materials in organic electrosynthesis, mechanistic investigations, theoretical calculations, mediators and other modes of electrocatalysis, unusual media, asymmetric electrosynthesis, and related areas. The purpose of this symposium is thus to bring together the leading scientists working in all these aspects, in order to stimulate intensive discussion and initiate/foster collaborations.

The symposium hosted 20 scientific presentations: 3 keynote and 5 invited lectures, 12 regular lectures and 19 posters. 1 poster prize was awarded together with Symposium 22.

**Symposium 22: Molecular Electrochemical Switches, Pumps, and Machines.** (Divisions 7 and 6)  
Organizing Committee: coordinator **Frank Marken** (University of Bath, UK), **Yitao Long** (Nanjing University, China), **Martin Edwards** (University of Utah, USA), **Do Hwan Kim, Jeong-Yun Sun**

Recent interest in biomimetic nanopores and nanoscale mechanisms has led to new concepts in nanopore functionalities, e.g. ionic diodes, electrolyte pumping, single molecule translocation, and in some cases coupled chemical processes that occur when ionic species are forced through nanopores. In the field of membranes, ionic diode phenomena and current rectification have been observed also for micro- and fluidic devices, again coupled in some cases to chemical reactivity, e.g. bipolar redox processes or water heterolysis. In this symposium, we would like to bring together contributions from inter-disciplinary areas including theory and simulation, nanopore electrochemistry, microfluidic, membrane devices, and molecular systems that provide (photo-)electrochemical functionality leading to switches, pumps, and machines. The idea is to develop new bio-mimetic processes that allow electrical energy applied to a membrane to be converted into chemical energy (including concentration gradients and chemical transformations).

The symposium hosted 12 scientific presentations: 3 keynote lectures, 9 regular lectures and 6 posters. 1 poster prize was awarded together with Symposium 19.

## 2.2. Jaroslav Heyrovský Prize for Molecular Electrochemistry

Since 2014 our Division selects each year a winner of the Jaroslav Heyrovský Prize for Molecular Electrochemistry. Previous recipients were Flavio Maran (2014), R. Daniel Little (2015), Ismael Díez Pérez (2016), Armando Gennaro (2017), Siegfried Waldvogel (2018), Christian Amatore (2019) and Justin Gooding (2020). This year the award goes to **Kevin Moeller** (2021).

**All members of Division 6 are cordially invited to nominate and re-nominate their candidates by the deadline 1 May, 2022. Candidates who received the prize are not eligible.** Please, follow the instructions at <https://www.ise-online.org/awards/heyrovsky.php>

### 2.3. Division 6 supported meetings

Our division planned to sponsor 2 meetings in 2020-2021, namely Modern Electrochemical Methods XL (2020) and Frumkin Symposium. Both symposia are now rescheduled for the end of the year 2021 and financial support of our Division is envisaged.

**Please, consider applying for sponsorship of your symposium by Molecular Electrochemistry division.** For more information go to <https://www.ise-online.org/ise-sponsoring/sponsoring-info.php> or contact directly any divisional officer via an email.

## 3. Planned Scientific Activity

### 3.1. ISE annual meetings

We will co-organize **4 scientific symposia** at the 73<sup>rd</sup> Annual Meeting of ISE in Xiamen, China. They relate to use of Molecular Electrochemistry in different fields like electrosynthesis, electronic materials, displays, smart analysis or green (electro)chemistry.

#### **Symposium 6: Enzymes and Bioinspired Molecular Objects for (Bio)Electrocatalysis and (Bio)Electrosynthesis.** (Divisions 2 and 6)

Organizing Committee: coordinator **Nicolas Plumeré** (Technical University of Munich, Germany), **Vincent Artero** (CEA-Grenoble, France), **Anne Jones** (Arizona State University, USA), **Fei Wu** (University of Chinese Academy of Sciences, China)

(Bio)electrocatalysis and (bio)electrosynthesis are attractive processes in a sustainable context. Enzymes are very specific and efficient catalysts. Biodiversity and enzyme engineering offer new opportunities in energy conversion, electrosynthesis, CO<sub>2</sub> valorization, and production of renewable fuels and added-value chemicals. Nevertheless, long term stability can limit their application. Bioinspired inorganic complexes and nanomaterials can take benefit of the knowledge of redox enzymes while performing over longer duration. This symposium will discuss recent advances in this field with the main objective of bringing together bioelectrochemists and molecular electrochemists. Topics will include: enzyme and molecular electrochemistry; enzyme discovery and enzyme engineering (mutations, fusion of proteins); artificial enzyme and biohybrid system; minienzymes, biomimetic and bioinspired inorganic complexes; nanozymes; nanostructured interfaces to address redox enzymes, bioinspired models.

#### **Symposium 14: Advanced Electrochemical Processes for the Production of Chemicals** (Divisions 5, 4 and 6)

Organizing Committee: coordinator **Minhua Shao** (Hong Kong University of Science and Technology, China), **Carlos Martinez-Huitle** (Federal University of Rio Grande do Norte, Brazil), **Cheng Wang** (Xiamen University, China)

Electrochemical synthesis of value-added chemicals from nitrogen, carbon dioxide, water, and biomass using renewable electricity has attracted great attention. It provides an opportunity to store renewable energies. This symposium will cover electrochemical processes including but not limited to carbon dioxide reduction, nitrogen reduction, hydrogen evolution, oxygen evolution, and electrochemical hydrogenation reactions. In particular, electrocatalyst design, synthesis and evaluation, theoretical modelling, system optimization, economic feasibility are welcome.

**Symposium 18: Cutting Edge Electrolysis and Electrochemical Technologies.** (Divisions 5 and 6)  
Organizing Committee: coordinator **Xiao Su** (University of Illinois at Urbana-Champaign, USA), **Gerardine G. Botte** (Texas Tech University, USA), **Haichao Xu** (Xiamen University, China)

Within the goals of electrification and integration of electrochemical technologies in the industry, this symposium will cover topics such as: hydrogenation, Electrosynthesis, Electrification) systems modelling, techno-economics analysis, life cycle analysis.

**Symposium 19: Molecular Electrochemistry and Electronics: from Principles to Devices.** (Divisions 6 and 7)

Organizing Committee: coordinator **Magdaléna Hromadová** (J. Heyrovský Institute of Physical Chemistry, Czech Republic), **Ismael Díez-Pérez** (King's College London, UK), **Angel Cuesta-Ciscar** (University of Aberdeen, UK), **Wenjing Hong** (Xiamen University, China)

Main purpose of this symposium is to bring together the leading scientists working on the mechanistic issues of molecular transformations in redox active molecules towards desired functionalities and stimulating their discussion with the rest of the electrochemical community. Novel electrochemical, electrosynthetic, spectroscopic and theoretical approaches towards the molecular design and understanding of charge transfer and charge transport mechanisms in such molecules, single molecule junctions and molecule-based devices are welcome. Contributions developing new methodologies (advanced imaging, signal measuring techniques, experimental platforms) are encouraged.

**Symposium 20: Molecular Electrochemistry may Shine Light on Analytical Applications.** (Divisions 6 and 1)

Organizing Committee: coordinator **Olivier Buriez** (ENS Paris, France), **Neso Sojic** (University Bordeaux, France), **Conor Hogan** (La Trobe University, Australia), **Guobao Xu** (Changchun Institute of Applied Chemistry, China)

In recent years, the combination of molecular electrochemistry and luminescence has begun to show significant potential for the development of superior new analytical strategies. Accordingly, this

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

Next annual meetings are: 74<sup>th</sup> Annual ISE meeting in Lyon, France in 2023 and 75<sup>th</sup> Annual ISE meeting in Montréal, Canada in 2024. **All Division members are invited to submit their Symposium proposals to any Divisional officer** via email. The officers are more than happy to provide current information on the schedules and deadlines.

### 3.2. ISE topical meetings

Due to the COVID situation we have not participated in any of the topical meetings in 2021. Next topical meeting to be sponsored by our division is **33<sup>rd</sup> topical meeting of ISE in Santiago, Chile** which is scheduled for **27-30 November, 2022** (this is an originally postponed meeting that was supposed to be held in 2020 and then in 2021). **Please, consider suggestions for the future topical meetings to be sponsored by Molecular Electrochemistry division.**

## 4. Budget

Divisional Budget at the beginning of 2021 was **7,175.12€**, which included new allowance of **2,573.04€** calculated based on the number of Division members in 2021. EC decided that **normal rules will apply** for transfer of the unused residual budget at the end of the fiscal year **2021**. Thus, our Division can still support organization of international meetings (even on-line ones) as well as travel grants for young Division members to such conferences. Each year we also award the J. Heyrovský prize for Molecular Electrochemistry (**750 €**). In 2021 our Division sponsored one waiver of the 72<sup>nd</sup> Annual ISE meeting fee (**200 €**) and three poster prizes, which were co-sponsored by Divisions 1, 2 and 7 (**375 €**).

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On behalf of Division 6  
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