Division 7 Physical Electrochemistry 2025 Report

Division 7 officers:

Mark Symes, University of Glasgow (Chair)

Katrin F. Domke, University of Duisburg-Essen (Past Chair)

Julia Kunze-Liebhäuser, University of Innsbruck (Chair Elect)

Clotilde Cucinotta, Imperial College London and Jun Cheng, Xiamen University (Vice-Chairs, 2025-2026)

The activities of Division 7 in 2024/5 are summarised below:

Organization and co-organization of symposia at annual ISE meetings
1) 76th Annual Meeting of the ISE, 7-12 September 2025, Mainz, Germany

Division 7 is involved in organizing the following symposia:

Symposium 13 Mechanisms in molecular electrochemistry for (bio-)catalysis, (bio)sensing and electronics
Sponsored by: Division 6: Molecular Electrochemistry, Division 1: Analytical Electrochemistry, Division 2: Bioelectrochemistry & Division 7: Physical Electrochemistry

Description: A simple electron (/charge, in general) transfer taking place at molecular level can be at the origin of many contemporary applications in very diverse fields of our daily life.
This symposium is focused on recent advances in the charge and mass transfer/transport processes occurring at electrode surfaces, suitably functionalized with new electroactive, bio-inspired and biomimetic molecules (including polymers). The novel materials and architectures, designed and crafted at molecular level, can enable unprecedented functionality from the physical electrochemistry point of view concerning charge transfer/transport properties. Furthermore, they can serve as novel molecular components to devise low-cost, low-power (bio-inspired) electronics, optoelectronics, (bio-) chemical sensing platforms, highly efficient catalysts. The aim is to (i) highlight fundamental approaches to devise novel functionalized molecular systems, 2D and 3D material architectures, with particular attention to synthetic receptors and biomimetic interfaces, and (ii) investigate how the structure of molecules affects the molecular interactions, the charge transfer/transport phenomena in molecular systems, molecular junctions and (biomimetic) interfaces to develop reliable and robust molecular or nanoscale bio-inspired devices for next-generation (opto-)electronics, sensing and catalysis.

Symposium Organizers: ***Federico Polo (lead organizer),*** *Ca' Foscari University of Venice, Italy.* ***Magdaléna Hromadova,*** *J. Heyrovský Institute of Physical Chemistry, Czech Republic.* ***Hye Jin Lee,*** *Kyungpook National University, South Korea.* ***Valentina Pifferi,*** *University of Milan, Italy.* ***Kristina Tschulik,*** *Ruhr-University Bochum, Germany.*

Symposium 14 Experimental and theoretical methods for atomistic understanding of electrochemical interfaces
Sponsored by: Division 7: Physical Electrochemistry

Description: The chemistry of the electrode-electrolyte interface is a key factor for the performance of electrochemical devices such as fuel cells, batteries, electrolyzers, and capacitors. Capturing this interfacial

chemistry requires powerful experimental methods and simulations. From the experimental side, methods such as (operando) X-ray spectroscopy, vibrational spectroscopy, X-ray scattering, and scanning tunneling microscopy provide key insight into the morphology, composition and (electronic) structure of the interface. Meanwhile, theoretical methods provide insight into reaction mechanisms, molecular arrangements, kinetics, electronic structure properties, and atomic-scale dynamics. To disentangle the full complexity of interfacial chemistry, a combination of theoretical and experimental methods is often necessary. Therefore, this symposium not only provides a platform to discuss recent developments and results of advanced experimental and theoretical methods, but also fosters experiment-theory collaboration.

Symposium Organizers: ***Rik Mom (lead organizer),*** *Leiden University, Germany.*
Katharina Doblhoff-Dier, *Leiden University, Germany.* ***Helmut Baltruschat,*** *Uni Bonn, Germany.*
Olaf Magnussen, *Christian-Albrechts-Universität zu Kiel, Germany.*

Symposium 15 Artificial intelligence for electrochemistry
Sponsored by: Division 7: Physical Electrochemistry

Description: The fast development of artificial intelligence (AI) is transforming the world in many ways, and is also changing how scientists do research. Many long-standing problems in electrochemistry that electrochemists dream of solving, all of sudden, seem within reach with the help of AI. In this symposium, we wish to bring together researchers from different backgrounds to discuss in what ways AI can reshape electrochemistry, with particular emphasis on the following questions.
To what extent can AI acceleration on ab initio modeling of electrochemical systems bridge the gap between simulation models and experiment?
How far can AI push the spatial and temporal limits of state-of-the-art in situ/operando characterization techniques in probing electrochemical systems?
How can AI/robotics help close the loop of multi-level optimization of electrochemical systems ranging from materials design, hierarchical structure engineering to device optimization?

Symposium Organizers: ***Jun Cheng (lead organizer),*** *Xiamen University, China.*
Marialore Sulpizi, *Ruhr Universität Bochum, Germany.* ***Katrin Domke,*** *University of Duisburg-Essen, Germany.* ***De-en Jiang,*** *Vanderbilt University, USA.*

Symposium 16 General Session – Hidden treasures – diversity of electrochemistry
Sponsored by: All Divisions

Description: The symposium is intended to be a forum to present and discuss all ISE areas that are not covered or not sufficiently covered by the other symposia to provide a space for the full diversity of topics in electrochemistry. Moreover, the general session should be a forum for contributions of specific scientific topics of electrochemistry, which are of high importance but not yet large enough for an entire symposium. Hence, this symposium aims to encourage research in the fields of electrochemical sciences and technology, as well as increase interest in and involvement in ISE among the participants, and provide the opportunity to discuss recent advances in electrochemical research with industrial partners. For this, and taking into consideration that the competition for oral presentation slots is extremely high, the symposium will also provide the possibility for short presentations of PhD students covering all topics of electrochemistry.
Possible topics comprise but are by no means limited to:

1. 30 years after Heinz Gerischer: New aspects of semiconductor electrochemistry
2. Basic electrochemistry of functional materials (perovskites, MOFs, MXenes, …)
3. Nanoelectrochemistry and nanoelectrochemical tools
4. Electrochemistry in confined volumes
5. Electrochemistry at liquid-liquid interphases

Symposium Organizers: ***Wolfgang Schuhmann (lead organizer),*** *Ruhr-Universität Bochum Germany.* ***Priscilla G. L. Baker,*** *University of the Western Cape, South Africa.* ***Silvia Cere,*** *University of Mar, Argentina.* ***Zhong-Qun Tian,*** *Xiamen University, China.*

2) 77th Annual Meeting of the ISE, 2026, Sydney, Australia
Division 7 is planning to lead the organization the following symposia:

i) S14: In situ and operando methods for characterising electroactive materials and interfaces

Sponsored by Division 7

Description: Electrochemical interfaces are inherently dynamic systems in which macroscopic behaviour is governed by molecular and electron transfer processes at the electrode surface, as well as complex physical, chemical, structural changes taking place in the bulk. Understanding the relationship between these properties and the electrochemical characteristics of such systems is critical to a wide variety of applications ranging from energy conversion and storage (e.g., batteries, fuel cells, electrolysers) to sensing and corrosion. In situ and operando methods provide a powerful means to probe these properties under electrochemically controlled conditions, and new innovations continue to emerge which couple electrochemical analysis with spectroscopy, scattering and microscopy. This includes techniques such as:

- Optical methods (UV-visible, IR, Raman, and surface-enhanced spectroscopy)
- X-ray spectroscopy (absorption, emission, photoelectron spectroscopy)
- X-ray diffraction and 3D computed tomography
- Magnetic resonance (NMR, EPR)
- Scanning probe microscopy (AFM, STM, SECM and related techniques)

New developments in instrumentation and increasing access to national facilities such as synchrotrons has opened up many new opportunities to explore electroactive materials and interfaces in unprecedented detail. Combining such methods with theory, modelling and simulation allows a much more complete picture of electrochemical systems and how they evolve, to be painted.
This symposium aims to bring together advances in the practice of in situ and operando characterisation of electrochemical systems, both from an experimental and theoretical standpoint. Emphasis is placed on showcasing methodological developments and new instrumentation, while highlighting how these advanced techniques can provide new insights into interfacial reactions and processes to support materials selection and development.

Symposium Organizers:

Andy Wain (Coordinator), National Physical Laboratory, United Kingdom, andy.wain@npl.co.uk

Heng-Liang Wu, Center for Condensed Matter Sciences, National Taiwan University, Taiwan, hengliangwu@ntu.edu.tw

Vincent Vivier, Laboratoire de Réactivité de Surface, Sorbonne Université, France, vincent.vivier@sorbonne-universite.fr

Veronica Augustyn, Department of Materials Science and Engineering, North Carolina State University, USA, vaugust@ncsu.edu

ii) S15: Model electrodes to study nanoscale phenomena in electrocatalysis

Sponsored by Division 7

Description: In electrocatalysis, wet chemical methods are commonly used to synthesize electrocatalyst nanoparticles, typically in the form of slurries, so-called “inks”, including additional materials and compounds such as carbon particles and binders (ionomers). While considered state-of-the-art and practical for manufacturing electrodes, such inks feature complex, often undefined, nanoparticle structure, morphology, chemical composition, and mass transport properties. This makes it challenging to assess the intrinsic electrocatalyst activity and decouple it from non-kinetic factors, hence limiting our ability to define reliable electrocatalyst design criteria towards enhanced performance.
This symposium aims to discuss - and stimulate research on - nanofabrication tools for model electrocatalysts and electrodes, with minimized chemical and material complexity, and with defined electrocatalyst loading, size, structure, composition, and mass transport properties, and how such defined structures can be used to investigate nanoscale phenomena and effects in electrocatalysis.
Highly defined (model) electrodes serve to better understand structure- and composition-activity relationships, and mechanisms emerging in supported nanoscale systems like (electronic) metal support interactions, bifunctional mechanisms, laterally structured double layer properties, electrolyte effects, etc. The symposium aims to discuss the current understanding of these phenomena, and how to discriminate between them experimentally, and in complementarity with theoretical work through modelling and computational methods.

Symposium Organizers:

Marco Altomare, Associate Professor, University of Twente, Netherlands
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Katharina Krischer, Full Professor, Technical University of Munich, Germany
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Jun Huang, Junior Professor, Forschungszentrum Jülich, RWTH Aachen University, Germany
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Division 7 is planning to co-sponsor the following symposia, whose organization is being led by other divisions

S8, Progress in surface modification and mitigation of material degradation (led by Monica Santamaria and Samatha Gateman). Div 4 are leading.

S9: Fabrication and characterization of electroactive nanostructured materials. Div 4 are leading. Hiroki Habazaki and Damian Kowalski organizing.

S13: Molecular Electronics and Electrochemistry: From fundamentals to Function and Application. Div 6 leading. This symposium was formed by merging former S13 with former S14.

Description: This symposium will highlight electrochemical measurements across various configurations — including classical two-electrode systems used in traditional molecular electronics and molecular junction studies, three-electrode systems for classical electrochemical investigations, and hybrid four-electrode setups, enabling the investigation of charge transfer across molecular junctions under tunable electrochemical potential. It will also explore how this understanding can be harnessed for applications such as electrosynthesis, catalysis, molecular materials design, and molecular electronics. Particular emphasis

will be placed on advances at the intersection of electrochemistry and molecular electronics technologies, focusing on systems where molecules, whether in solution or solid state, as isolated entities or organized into assemblies such as self-assembled monolayers (SAMs), serve as functional chemical or active electronic components.

Contributions that use electrochemical measurements to understand and manipulate molecular structure, function, or chemical reactions are strongly encouraged. Investigations involving single-molecule junctions, nanogaps, nanopores, and other electrified interfaces with a focus on electronic functionality are also welcomed. In addition, the symposium will explore the impact of photo-electrochemistry and photo-luminescence on molecular systems, emphasizing how light-induced processes can influence charge transfer, reaction mechanisms, and molecular functionality, with potential applications in sensing, energy conversion, and molecular electronics.

Experimental studies integrating electrochemical, spectroscopic, and microscopic techniques, together with theoretical modeling of charge transfer and molecular dynamics, are encouraged. This symposium aims to advance our understanding of molecular-level charge control and its application to next-generation electrochemical investigations and emerging technologies.

Symposium Organizers:

Nadim Darwish, Curtin University, Perth
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Jiří Ludvík, The Czech Academy of Sciences
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Organization and co-organization of ISE Topical Meetings
Past Meetings:

- 38th ISE Topical Meeting, Nanomaterials in Electrochemistry (Manchester, UK), 8 - 11 September 2024.

Future Meetings:

- 42nd ISE Topical Meeting, Sustainable Electrochemical Energy Materials: Theory and Practice (Helsinki, Finland), 23-26 June 2026
- 43rd ISE Topical Meeting, In-situ and operando monitoring of electrified interfaces (Poznan, Poland), 27-30 September 2026

Sponsoring of International Conferences:

- CNRS-Africa Residential Research Schools HELIOS from 20/07/25 - 03/08/25, in Lome, Togo (with Division 3)
- Molecular and ion flows through angstrom-scale channels Faraday Discussion meeting from the 13/04/25 - 15/04/25, in Manchester, United Kingdom.

- International Symposium of AI on Electrochemistry 2025 (iSAIEC 2025) meeting, which will be taking place from 23/06/25 - 25/06/25 in Xiamen, China.

Awards

The the Alexander Kuznetsov Prize for Theoretical Electrochemistry 2025 was awarded to Prof Adam Weber in recognition of his groundbreaking contributions to multiscale modelling of electrochemical systems and the study of electrochemical interfaces.

Award Committee:
Mark Symes, University of Glasgow (chair)
Cucinotta, Clotilde, Imperial College London
Jun Cheng, Xiamen University
Mira Todorova, Max-Planck-Institute for Sustainable Materials
Jan Rossmeisl, University of Copenhagen (recused due to conflict of interest)

In 2026, the Division will be associated with the Brian Conway Prize in Physical Electrochemistry. An awards committee will be assembled in due course, chaired by Mark Symes.