ISE Division 4
ELECTROCHEMICAL MATERIALS SCIENCE
Report 2009

Chair: T. Moffat (thomas.moffat@nist.gov)
Past Chair: W. Kautek (Wolfgang.Kautek@univie.ac.at)
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Vice-Chairs: M.P. Ryan (m.p.ryan@imperial.ac.uk)
Y. Fukunaka (hirofukunaka@yahoo.co.jp)

ISE Meeting Activities

60th Annual ISE Meeting – Beijing, China

"Division Lucheon Meeting"

Thursday 20 August 12:30 to 13:45,
Room 315, 3rd Floor, Lee Shau Kee Building
Vice Chair Mary Ryan chaired the Division 4 Lucheon giving an update on the Division's activities. This was followed by a discussion and solicitation for ideas and topics for future symposia.

Division 4 sponsored or co-sponsored three symposia

Symposium 2: Corrosion Science and Technology

The goal of this symposium is to address a wide range of issues pertinent to corrosion science and technology, including corrosion in liquid and gaseous phases, and at high temperatures. This symposium will devote a dedicated stream to this important area and address all aspects of corrosion and associated phenomena in liquid and gaseous phases, and high temperature environments.

Topics include but are not limited to:

• Localized corrosion, such as pitting and microstructure dependent forms of corrosion
• Passivity and surface treatment
• Coatings, inhibitors and claddings
• Corrosion on the micro/nano-scale; corrosion of nanomaterials
• Modeling corrosion phenomena, including lifetime prediction
• Marine and microbiologically influenced corrosion
• Corrosion of structural materials
• New techniques and analysis methods in the study of corrosion
• High temperature corrosion and oxidation

Symposium organizers

Nick Birbilis, (Coordinator), *Monash University, Australia* nick.birbilis@eng.monash.edu.au
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Symposium 6: Electrodeposition for Nanoelectronic Applications

This symposium will highlight progress in all fundamental aspects of metal and semiconductor deposition as well as the electrochemical preparation and electrochemical properties of new materials. Emphasis is placed on electrodeposition for nanoelectronics and for electrochemical applications in energy conversion or sensors.

Topics include but are not limited to:

• Surface engineering, surface patterning
• Self-organized 2D or 3D structure and pattern formation via dissolution or deposition processes
• Role of additives in controlling deposition processes
• Electrochemical approaches to new materials
• Nanocomposites by electrodeposition (magnetic materials; functional coatings, biomimicking materials and devices)
• Conducting and semiconducting materials prepared by and for electrochemical technologies

Symposium organizers

Yongfang Li, (Coordinator) *Institute of Chemistry, CAS, China* liyf@iccas.ac.cn
George Zheng Chen, *University of Nottingham, UK* george.chen@nottingham.ac.uk
Dieter M. Kolb, *University of Ulm, Germany* dieter.kolb@uni-ulm.de
Jay Switzer, *Missouri University of Science and Technology, USA* jswitzer@mst.edu
Mu Wang, *Nanjing University, China* muwang@nju.edu.cn

Symposium 4: Electrocatalysis

Division 4 cosponsored with Division 6, Molecular Electrochemistry and Division 7, Physical Electrochemistry

This symposium will offer an interdisciplinary discussion platform for new results, concepts and methodologies in electrocatalysis . Electrocatalysis has attracted great attention in recent years due to its essential role in fuel cells, electrosynthesis and biosensors. The investigation of electrocatalysis always involves new catalytic materials, novel *in-situ* methods, and profound understanding of catalytic reaction mechanisms and kinetics. The symposium will thus cover both fundamental aspects and the important applications of electrocatalysis.

Topics include but are not limited to:

• Structure and reactivity in electrocatalysis: single crystals, nanoparticles and dealloyed surfaces
• Spectroscopy at electrocatalytic interfaces, reaction mechanism and kinetics
• Theoretical and computational methods in electrocatalysis
• Electrocatalysis at immobilised redox centers and in ionic liquids
• Biological electrocatalysis: from biochemistry to biomimetic systems
• Carbon challenge: electrocatalytic capture of carbon dioxide
• Electrocatalysts and fuel cells

Symposium organizers:

Shi-Gang Sun, (Coordinator) *Xiamen University, China* sgsun@xmu.edu.cn
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Pei Kang Shen, *Sun Yat-Sen University, China* stsspk@mail.sysu.edu.cn
Peter Strasser, *Technical University Berlin, Germany-University of Houston, USA* pstrasser@uh.edu
Marcin Opallo, *Inst. of Physical Chemistry, Polish Acad. of Sciences, Poland* mopallo@ichf.edu.pl
Jeff Greeley, *Argonne National Laboratory, USA* jgreeley@anl.gov

Upcoming ISE Meetings

8th Spring Meeting, May 2 to 5, 2010 Columbus, Ohio, USA

Advances in Corrosion Science for Lifetime Prediction and Sustainability:
A Celebration of the 100th Birthday of Mars Fontana

Organizing Committee

Members

Gerald S. Frankel, *Ohio State University*
Gustavo Cragnolino, *Southwest Research Institute*
Ron Latanision, *Exponent*
Jesse Lumsden, *Teledyne*
Digby Macdonald, *Penn State University*
Philippe Marcus, *Ecole Nationale Superieure de Chimie de Paris*
Joe Payer, *Case Western University*
Bob Rapp, *Ohio State University*
Roger Staehle, *Staehle Consulting*
Martin Stratmann, *Max-Planck Institut für Eisenforschung*

Local Organizing Committee

Conference co-chair: Gerald S. Frankel, *Ohio State University*
Conference co-chair: Rudolph G. Buchheit, *Ohio State University*
Arun Agarwal, *DNV Columbus (a division of Det Norske Veritas)*
Barry Hindin, *Battelle*
Thodla Ramgopal, *DNV Columbus*
Narasi Sridhar, *DNV Columbus*
Neil Thompson, *DNV Columbus*

Advances in Corrosion Science for Lifetime Prediction and Sustainability:
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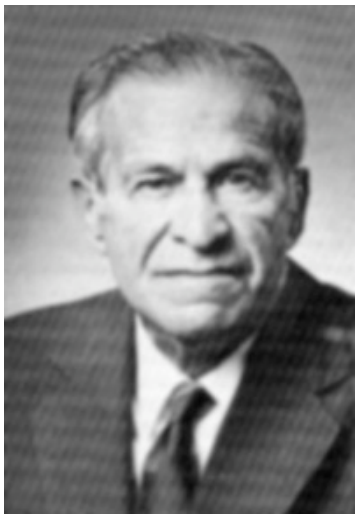

Mars G. Fontana

Mars G. Fontana was born on April 6, 1910. He became professor and then chairman of the Department of Metallurgical Engineering at The Ohio State University. Fontana can be considered the Father of Corrosion Engineering, as he was very involved in applying the corrosion fundamentals being developed at the time for solving real industrial applications. He was also a renowned educator. He taught a very popular course on corrosion and authored a textbook on the subject that was used worldwide for decades. One of his students, Roger Staehle, took over the corrosion lab in the sixties and developed a world-leading center for the study of corrosion, which he named the Fontana Corrosion Center. As a result of the efforts of Fontana, Staehle, and their successors, the Fontana Corrosion Center maintains an internationally leading position in corrosion research.

The centennial of Fontana's birth in 2010 provides an opportunity to celebrate his achievements and to convene a meeting focused on Fontana's specialty, application of corrosion fundamentals to solving real problems. In today's world, lifetime prediction and sustainability dominate corrosion engineering design.

Nice, France

Division 4 is sponsoring and co-sponsoring six symposia

Symposium 5
Electroactive Polymers, Inorganic Electroactive Solids, Nanocomposite Materials

We invite contributions related to all aspects of electroactive materials and their composites, from their synthesis and characterization to potential or actual applications. The participation of young researchers and scientists from interdisciplinary areas is strongly encouraged.

The scope of the symposium includes (but is not limited to) the topics:
- Synthesis and characterization of electroactive (conducting and redox) polymers and inorganic electroactive solids
- Electroactive nanocomposites containing metal, carbon, semiconductor or insulator particles/structures
- Electrocatalytic applications
- Electroanalytic applications, sensors and actuators
- Applications in energy storage, batteries and supercapacitors
- Applications in electrochromic and nonlinear-optic materials
- Applications in nanosciences and molecular electronics

Symposium organizers
Mikhail Vorotyntsev, (Coordinator) Università de Bourgogne, Dijon, France
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Galina A. Tsirlina, Moscow State University, Russia
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Symposium 6
Corrosion Science: Mechanisms and Methods

This symposium will cover all aspects of Corrosion Science.

Topics include but are not limited to:
- Growth and characterization of passive films and corrosion layers on metals and alloys
- Passivity breakdown and localized corrosion initiation
- Advanced in situ and ex situ techniques enabling a deeper understanding of corrosion processes at the micro- and nano-scale
- Modelling and simulation in corrosion science
- Novel techniques for corrosion protection (including advanced coatings and inhibitors)
- Anodisation, formation of porous structures
- Environmental degradation mechanisms of advanced materials
- Corrosion mechanisms of materials in practical environments

Symposium organizers
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Hiroki Habazaki, Hokkaido University, Sapporo, Japan
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Symposium 7
Electrodeposition for material synthesis and nanostructure fabrication

This symposium will focus on various aspects of electrochemical deposition of metals, semiconductors, metal oxides, organic polymers and composites. Emphasis is placed on fabrication of nanostructured architectures and new opportunities in design and manufacture of energy conversion, microelectronic, magnetic, and MEMS devises as well as sensors.

Topics include but are not limited to:
- Surface engineering and patterning: self-organized 2D or 3D structures and pattern formation via electrochemical dissolution or deposition approaches
- Role of solution additives such as surfactant in controlling deposition processes
- Electrochemical approaches for new materials: - nanocomposites obtained by electrodeposition (magnetic materials, functional coatings, biocompatible and biomimetic materials)
- New conducting and semiconducting materials and structures prepared by and for electrochemical technologies
- Novel experimental and theoretical methods for nanoscale characterization of deposit structure, properties, and phase formation
- Theory and modelling of electrochemical growth from elementary steps to final structures

Symposium organizers
Catherine Debiemme-Chouvy, (Coordinator) CNRS, UPMC University, Paris, France
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Stanko Brankovic, University of Houston, Houston, USA
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Michel Rosso, Ecole Polytechnique, Palaiseau, France
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Daniel Lincot, ENSCP, Paris, France
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Symposium 11
Sensors and biosensors

Sponsoring Divisions: Division 1, 2 and 4

This symposium aims to present a broad overview on developments in electrochemical sensors. Thus it covers fundamental approaches which can lead to a better understanding of electroanalytical and bioelectrochemical sensing systems, new sensor architectures but also applications in medicine, industry and environmental monitoring.
Two aspects of modern sensor research will be given special attention: The first focus will be on all problems of in vivo sensing. This is an important area in medicine with increasing needs. However until now only few commercialisations have been seen. Thus the symposium wants to discuss the perspectives and current problems. The second focus is on miniaturisation down to the nanoscale and on techniques for the characterisation of these sensorial nanostructures. With this the symposium wants to follow the actual developments in methods of nanostructure preparation, their application in sensors and the better understanding of their properties.

Thus the symposium will include following topics:
- Examples of in vivo sensing
- Calibration strategies for in vivo sensor application and materials issues
- Miniaturization of sensing structures
- Imaging techniques for sensor surface characterization (eg. STM, AFM, SECM)

- Application of nanostructures
- Nanobiochips
- New sensor concepts
- Biomimetics

Symposium organizers
Fred Lisdat, (Coordinator) Wildau University, Germany
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Féthi Bédioui, ENSCP, Paris, France
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Symposium 12
Electrochemistry on a local scale

Sponsoring Divisions: Divisions 1, 4, 6 and 7

This symposium will focus on new approaches to access morphology, chemical composition and local reactivity on a local scale. Subjects in the symposium will also cover issues associated with electrochemical consequences of novel interfacial phenomena of a small number of molecules, ions, electrons and photons. The recent advances in the area of nano-scale electrochemistry will be discussed based on the state-of-the-art experimental and theoretical methodologies, including but not limited to ultra-sensitive spectroelectrochemical detections, nano-structuring at electrochemical interfaces and quantum-oriented electrochemical theories.

Topics will include but are not limited to:
- Development of combined (AFM-SECM, AC-SECM, shear-force SECM, EC-STM...) imaging techniques providing complementary local information of electrochemical systems
- New strategies of ex-situ microanalytical techniques for local composition analysis of reactive materials: meeting challenges of lateral resolution and transfer effects
- New developments for local in-situ spectroscopy of electrochemical systems
- Theory and simulations of local phenomena and their influence on macroscopic systems (multi-scale problems with particular relevance to recent experimental developments)
- Applications of novel (or innovative) local characterisation techniques for reactive micro- and nanostructures, and single object (molecule or species) electrochemistry

Symposium organizers
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Gunther Wittstock, Carl von Ossietzky University, Oldenburg, Germany
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Symposium 13

Surface Functionalization

Sponsoring Divisions: Division 1, Analytical Electrochemistry and Division 4, Electrochemical Materials Science

Electrochemistry is in essence a science of the interface, and modifications of the composition and structure of the electrode surfaces by functionalization is the key for the control of molecular dynamics and electronic transfers. Consequently, this symposium will cross other aspects of various symposia including (bio)molecular recognition, electrocatalysis, electroanalysis, photoelectrochemistry. The symposium will focus on the development of functional surfaces electrochemically prepared (nano- and micro-structuring and patterning, deposition, polymerization and grafting) or chemically prepared and electrochemically studied, activated and triggered (molecular switches, motors). The cross-fertilization between functionalization and nano-systems and nano-objects will be emphasized.

Topics will include:
- Electrografting and electropatterning (dissolution, deposition processes)
- 2D and 3D assemblies and self-organized structures including SAMs, LbL, redox, conjugated polymer and composites films
- Nano-objects (including organic and inorganic nanowires, carbon nanotubes, graphene sheets and nanoparticles) growing and/or functionalization, positioning onto surfaces for electroanalysis, sensors, molecular electronics and photonics
- Modification of electrode surfaces with nanostructured systems for electroanalysis and molecular electronics and photovoltaic
- Functionalization at the micro- and nano-scale, tools to build up, characterize and model

Symposium organizers
Gérard Bidan, (Coordinator) INAC/CEA-Grenoble, France
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Planning is underway for the 62nd 2011 that will be held September 11-16 in Niigata, Japan. Please feel free to contact the Division 4 Executive Committee if you have ideas or topics for potential symposia. Likewise, if you would like to take part in the development and organization of a particular symposium please let us know. We welcome your ideas and participation in this important process.

Sponsored External Meetings 2009-2010

2nd International Symposium on Surface Imaging /Spectroscopy at the Solid/Liquid Interface, May 31-June 3, 2009, Cracow, Poland

Conservation of Archaeological and Historic Metallic Artifacts: The need for Electrochemical Techniques, January 11-15, 2010, Leiden, The Netherlands

The workshop will offer a discussion platform for all active professionals (conservators, conservation scientists and analytical scientists) interested in, or involved with, the use of electrochemical techniques for the conservation of archaeological and historic artifacts.

EuroInterfinish 09, Sept 23-24, 2009, Bremen, Germany

8th International Symposium on Electrochemical Impedance Spectroscopy, June 6-11, 2010, Carvoeiro, Algarve, Portugal

11th International Fischer-Symposium on "Microscopy in Electrochemistry", Monastery of Benediktbeuern, Germany, July 26-31, 2009.

2nd International Conference on Functional Nanocoatings
March 28-31, 2010 Dresden, Germany

+ two applications pending.

Awards

Hans-Jürgen Engell Prize
The Hans-Jürgen Engell Prize is awarded annually to a young electrochemist on the basis of published work in the field of corrosion, electrodeposition or surface treatment. (Applications for next award in 2010: from February 1st to May 1st, 2010, Chair of the Award Committee: Thomas Moffat)

Winner 2008: ***Ismael Díez-Pérez****, Arizona State University, USA*
Lecture at 60th Annual Meeting 2009, August 16 - 21, Beijing, China
Tuesday 18 August 2009, 15:40 to 16:00, Room 105

Winner 2009: ***Karl Mayrhofer****, Tecnische Universitat Munchen, Germany*
(Lecture to be given at 61th Annual Meeting 2010, September 26-Oct 1, Nice France)

Respectfully submitted
Tom Moffat
Chair, Division 4