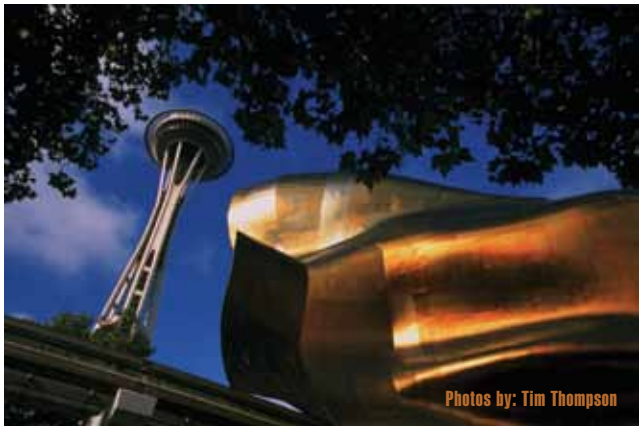
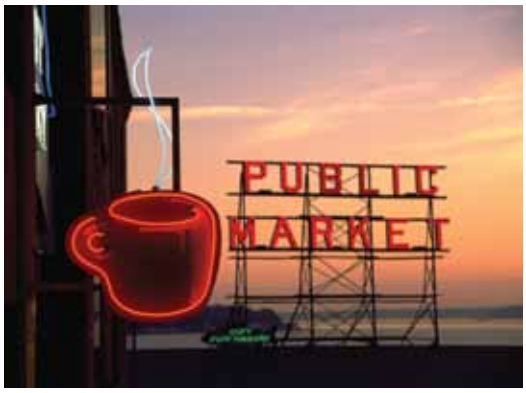
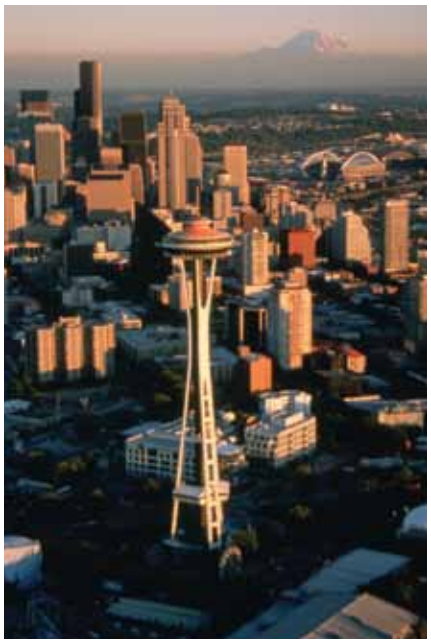
Registration



Photos by: Tim Thompson





221st ECS Meeting

Seattle, WA

May 6-10, 2012

Washington State Convention Center and the Sheraton Seattle Hotel

Featured Speakers

The ECS Lecture

Monday, May 7

Will It Be a Tank of Lithium to Drive Our Next Car?

by Bruno Scrosati

Back in 1800, when Alessandro Volta, professor at the University of Pavia in Italy, unveiled his "electric pile" to Napoleon Bonaparte, he could not have imagined that his invention—mainly the fruit of a dispute with his colleague-competitor Luigi Galvani at University of Bologna—would have opened a route that, via various progressive technological evolution steps, did eventually lead to the development of the electrochemical power source that today dominates the consumer electronics market. This is the lithium battery, currently produced at a rate of several billions of units per year. This talk will illustrate the evolution of these important energy storage devices, from their early stages to the present worldwide intense research activities aimed to further improve their properties and characteristics. Also discussed will be the various new electrode and electrolyte materials that are currently being investigated as a way to upgrade the energy content of the batteries so as to deal with the new challenges opened by the expected advent of a wide road electrification. Lithium batteries are facing a second, new age: as the first one led to the revolution in the consumer electronic market, the new one is expected to favor an epoch-making change in vehicle transportation.

The Vittorio de Nora Award Lecture

Monday, May 7

Lithium-Sulfur and Lithium-Air: The Superbatteries of the Future

by Bruno Scrosati

Li-ion batteries today exceed by a factor of at least 2.5 any competing technology, thanks to the high value of energy density, i.e. 150 Whkg-1 and 650 Whl-1. Due to their unique features, these batteries are the power sources of choice for the portable electronics market (including popular products such as cellular phones, laptop computers, MP3s, etc.) and are aggressively entering in the power tool equipment market and, in particular, in the emerging sustainable vehicle market.

However, the present Li-ion batteries, although commercial realities, are not yet at such a technological level to meet the power requirements of efficient hybrid or electric vehicles. Reduction in cost, enhancement in safety and rate, and, especially improvement in energy density, are mandatory requirements. It is now clear that jumps in energy density may only be achieved by renewing the lithium battery concept, passing from conventional intercalation to an advanced conversion chemistry. The most significant examples are provided by the lithium-sulfur and the lithium-air systems, in principle capable to provide 3-5 times enhancement in energy density. However, the practical exploitation of these "superbatteries" is still hindered by a series of issues, mostly associated with electrolyte incompatibility with electrode materials.

In this presentation, after a brief introduction on the basic characteristics of lithium-ion cells, the research currently in progress in our laboratory for upgrading the performance of lithium-sulfur and lithium-air batteries are reviewed and discussed. It will be shown that most of the operational issues may be effectively addressed by the use of innovative, stable electrolytes, combined with the development of appropriate electrode morphologies.

Bruno Scrosati is Senior Professor of Electrochemistry at the University of Rome La Sapienza. In 1990 he was the George T. Piercy distinguished visiting professor in the Department of Chemical Engineering & Materials Science at the University of Minnesota, and in 1991 was a visiting professor in the Department of Chemical Engineering & Materials Science at the University of Pennsylvania. Presently, he is a visiting professor in the Department of Energy Engineering ar Hanyang University in Seoul, Korea. In 1990-92 he was President of the International Society of Solid State Ionics and in 1996-1998 President of the Italian Chemical Society. He was elected Vice-President (2000) and President (2003-2004) of The Electrochemical Society. In 1996 he received the title of Doctor in Science *honoris causa*, Hon. Dsc. from the University of St. Andrews in Scotland. In 1997 he received the ECS Battery Division Research Award. In 2004 he won the XVI edition of the Italgas Prize, noted for science and environment, specifically for "his studies, which provide consistent evidence that the new, morphologically optimized materials approach the performance levels requested for batteries and fuel cells designed for electric vehicle applications." In 2005 he was named a Fellow of The Electrochemical Society and in 2007 a Fellow of the International Society of Electrochemistry. In 2006 he received the Volta Medal of the ECS European Section, and in 2007 the "Sigillo d'oro" Medal from the Italian Chemical Society. In 2008 he received an honorary doctorate in science and technology from the Chalmers University of Technology, Goteborg, Sweden.

Dr. Scrosati is the European editor of the *Journal of Power Sources* and a member of the editorial boards of various international journals, which include *Solid State Ionics*, *Journal of Applied Electrochemistry*, *Progress in Solid State Chemistry*, and the *Journal of New Materials for Electrochemical Systems*. Professor Scrosati has coordinated several national and international research projects devoted to the studies of materials for energy storage electrochemical devices. He was Chair of the 1st International Conference on Lithium Batteries (IMLB 1), the 1st International Conference on Polymer Batteries and Fuel Cells (PBFC 1), promoter and chair of the Japan-Italy-Germany Electrochemical Seminar, and of the Korea-Italy-Swedish Electrochemical Seminar. All these have become regular and established international events. He has been an invited speaker at many international conferences. Prof. Scrosati is author of more than 450 scientific publications, 30 books and chapters in books, and 18 patents. His H-factor is 48.

Henry B. Linford Award for Distinguished Teaching Lecture

Monday, May 7

Electrochemical Impedance Spectroscopy

by Mark Orazem

Electrochemical impedance spectroscopy is a powerful, sensitive, and minimally invasive *in situ* electrochemical technique that can provide quantitative descriptions of electrochemical systems. The applications are broad, including corrosion and corrosion control; electrochemical kinetics and mechanisms; electronic and ionic conducting polymers; semiconducting electrodes; semiconductors, solid electrolytes, and electronic conductors; energy storage, batteries, fuel cells; and biological systems. While instrumentation is readily available to make impedance measurements, the challenge lies in interpreting the spectra in terms of physically meaningful properties. This talk will provide an introduction to impedance spectroscopy, including an historical perspective, physical interpretation of the measurement, and challenges for the future.

Mark Orazem obtained his BS and MS degrees from Kansas State University and his doctorate in 1983 from the University of California, Berkeley. In 1988 he joined the faculty of the University of Florida where, since 1992, he holds the position of Professor of Chemical Engineering. Orazem's work on electrochemical impedance spectroscopy has encompassed corrosion, fuel cells, batteries, biomedical processes, and electronic materials. His measurement model approach, developed in collaboration with researchers in France and the University of South Florida, provides a powerful method for statistical analysis of impedance data. Orazem and his collaborators have developed a new interpretation of the frequency dispersion seen in the impedance response of oxides. These concepts have been applied by the leading manufacturer of heads for computer hard drives to monitor the oxide thickness during fabrication.

With Bernard Tribollet, he has co-authored a textbook on impedance spectroscopy, published in 2008 by John Wiley & Sons as part of The Electrochemical Society monograph series.

Orazem has delivered plenary and keynote lectures on impedance spectroscopy, including plenary lectures delivered at the Electrochemical Methods in Corrosion Research conference (EMCR 2006, Dourdan, France), the 7th International Symposium on Impedance Spectroscopy (2007, Argéles sur Mer, France), and the XXVI Congreso de la Sociedad Mexicana de Electroquimica (2011, Mexico City). He organized the 6th International Symposium on Electrochemical Impedance Spectroscopy, held in Cocoa Beach, Florida in May 2004, and served as Guest Editor for a special issue of *Electrochimica Acta* on Electrochemical Impedance Spectroscopy, published in January 2006. Orazem delivers courses on Impedance Spectroscopy for companies and professional societies. In 2011, his courses were offered for The Electrochemical Society, GenTex Corporation, the Rocky Mountain Section of the Materials Research Society, la Sociedad Mexicana de Electroquimica, and l'Institut Carnot CIRIMAT in Toulouse, France.

Orazem has been recognized as a Fellow of The Electrochemical Society. He was an Associate Editor for the *Journal of The Electrochemical Society* for 10 years, and he is now the President of the International Society of Electrochemistry. He was recognized as the 2005 College of Engineering Distinguished International Educator, he received the 2006 Excellence in Teaching Award from the student chapter of the AIChE, and he received the 2008 UF Blue Key Distinguished Professor Award. In recognition of his contributions to their training program, BP Azerbaijan presented Orazem with their 2005 Outstanding Service Award.

Carl Wagner Memorial Award Lecture

Monday, May 7

The Lithium Battery

by Peter Bruce

The rechargeable lithium battery is one of the most successful electrochemical technologies of the past few decades. It has transformed portable electronics, is the technology of choice for battery electric vehicles, and will have a key role in balancing the intermittent supply of electricity from renewable sources with consumer demand. However, to meet the needs of new markets in the medium to long term, new generations of rechargeable lithium batteries are necessary and this in turn requires a step-change in the underpinning electrochemical science.

The operation of Li-ion batteries depends on Li intercalation. The talk will consider the effect of nanostructured intercalation electrodes for Li (nanotubes, nanowires, and mesoporous solids) on the intercalation process. Such nanostructured materials, in which lengths are controlled simultaneously on the micron, nano, and atomic scale, will be compared with the equivalent bulk and nanoparticulate intercalation hosts. To meet the long term needs of energy storage it is necessary to go beyond lithium-ion batteries. One approach is the lithium-air battery, which theoretically could deliver a battery electric vehicle with a 300 mile driving range. The underlying scientific challenges that face technological realization of this energy storage device will be discussed.

Peter G. Bruce FRS, FRSE, FRSC, is the Wardlaw Professor of Chemistry at the University of St. Andrews, Scotland. His research interests embrace materials chemistry and electrochemistry, especially the synthesis and characterization of new and novel materials (extended arrays and polymers) with new properties or combinations of properties for new generations of lithium batteries. Recent efforts have focused on the synthesis and understanding of nanoelectrodes for lithium-ion batteries, including nanowire/nanotube intercalation anodes (TiO_2) and mesoporous cathodes ($LiMn_2O_4$), novel approaches to high capacity lithium batteries (the lithium-air battery), and the influence of order on the ionic conductivity of polymer electrolytes. His research has been recognized by a number of awards and fellowships, including from the Royal Society, the Royal Society of Chemistry, the German Chemical Society, and The Electrochemical Society. He was elected to the Royal Society (UK Academy of Sciences) in 2007 and the Royal Society of Edinburgh (Scottish Academy of Sciences) in 1994.

Hotel Reservations Information

The 221st ECS Meeting will be held at the Sheraton Seattle (1400 Sixth Avenue, Seattle, WA 98101) and the Washington State Convention Center (800 Convention Place, Seattle, WA 98101). We strongly encourage you to stay at the meeting headquarters hotel, the Sheraton Seattle, where your stay will be most enjoyable and convenient. Reservations can be made online from the ECS website at special discounted meeting rate of **$169**. See the ECS website for more details and to make your reservation.

The deadline for reservations is April 6, 2012. Reservations attempted after April 6 will be accepted on a space and rate availability basis.

Companion Registrant Program

Guests of Technical Registrants are invited to register for the 221st Meeting as a "Companion Registrant." The companion registration fee of $30 (after April 6) includes admission to non-ticketed social events, an exclusive lounge with beverage service, Monday through Thursday, 0800-1000h, and a special "Welcome to Seattle" orientation presented by Seattle's Convention and Visitors Bureau on Monday, May 7 at 0900h in the Companion Registrants Lounge.

Please note that online registration is not available for Companion Registrants. For your convenience, you may register using the attached Registration Form.

Short Courses and Tutorials

Six Short Courses will be offered in conjunction with the 221st ECS Meeting. These courses will be held on Sunday, May 6, 2012, from 0900h to 1600h. The registration fee is $425 for ECS members and $520 for nonmembers. **Students are offered a 50% discount.** The registration fee for the short courses covers the course, text materials, continental breakfast, luncheon, and refreshment breaks; it is not applicable to any other activities of the meeting. The half-day Tutorial fee is $212.50 (members and nonmembers), and the student fee is $106.25. If you are an employee of an ECS Corporate Member, the fee is $25. **The deadline for registration for a course is April 6, 2012.** Interested parties may register using the Registration Form in this brochure. Written requests for refunds will be honored only if received at ECS headquarters before April 13, 2012. **Pre-registration is required.** All courses are subject to cancellation pending an appropriate number of advance registrants.

Visit the ECS website for full course descriptions and instructor biographies.

Short Course #1

Enantioselective, Electrochemical Sensors: Design, Response Characteristics, and Applications

Raluca-Ioana van Staden, Instructor

This course is intended for chemists, physicists, materials scientists, and engineers with an interest in applying electrochemical sensors to enantioanalysis. The discrimination between enantiomers using enantioanalysis is becoming one of the most important fields of modern analytical chemistry, especially for pharmaceutical analysis and clinical analysis/biomedical analysis. The course is best suited for an attendee who has basic knowledge of electrochemical sensors. The attendee will develop a basic understanding of the principles of molecular recognition of enantiomers, types of electrochemical sensors which can be used for enantioanalysis, design of enantioselective, electrochemical sensors, response characteristics, and the reliable application of the electrochemical sensors in enantioanalysis of compounds of pharmaceutical and clinical/biomedical interest. The topics to be covered include:

- Principles of molecular recognition of enantiomers using electrochemical sensors;
- Types of enantioselective, electrochemical sensors used in enantioanalysis: enantioselective, potentiometric membrane electrodes; enantioselective, amperometric sensors, stochastic sensors, biosensors, immunosensors, multimode sensors; general aspects;

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- Mechanism of potential development and enantioselectivity for potentiometric, enantioselective membrane electrodes;
- Design of enantioselective, electrochemical sensors;
- Response characteristics of enantioselective, electrochgemical sensors;
- Simultaneous assay of enantiomers using enantioselective, electrochemical sensors; and
- Applications of enantioselective, electrochemical sensors in pharmaceutical and clinical/biomedical analysis.

Short Course #2

Fundamentals of Electrochemistry
Jamie Noël, Instructor

This course is suited to people with a physical sciences background who have not been trained as electrochemists, but who want to add electrochemical methods to their repertoire of research approaches. There are many fields in which researchers originally approach their work from another discipline but then discover that it would be advantageous to understand and use some electrochemical methods to complement the other work that they are doing. The course will cover the following areas:

- Introduction and Overview of Electrode Processes
- Chemical vs. Electrochemical Thermodynamics
  - cell potentials, Nernst equation, electrode-solution interface, double-layer structure, and adsorption
  - applications in analytical electrochemistry and sensors
- Chemical Stoichiometry vs. Faraday's Law
  - coulometry, bulk electrolysis
- Chemical vs. Electrochemical Kinetics
  - electrode reactions, rates, mechanisms and rate constants, mass transport, Butler-Volmer, Tafel, and Levich equations
- Kinetic Methodology
  - potential step and sweep methods, polarography, controlled-current techniques, controlled mass transport approaches, rotating electrodes, microelectrodes, electrochemical impedance spectroscopy
- Electrochemical Instrumentation
  - voltmeters, potentiostats, cells

and time permitting

- Scanning Probe Techniques
  - scanning electrochemical microscopy, AFM, etc.
- Coupled Characterization Methods
  - modified electrodes, spectroelectrochemistry, *in situ* neutron scattering, surface analysis, etc.

Short Course #3

Basic Impedance Spectroscopy
Mark E. Orazem, Instructor

This course is intended for chemists, physicists, materials scientists, and engineers with an interest in applying electrochemical impedance techniques to study a broad variety of electrochemical processes. The attendee will develop a basic understanding of the technique, the sources of errors in impedance measurements, the manner in which experiments can be optimized to reduce these errors, and the use of graphical methods to interpret measurements in terms of meaningful physical properties. The topics to be covered include:

- The motivation for using impedance spectroscopy advantages as compared to other transient techniques and the conditions under which its use is ideally suited;
- The basic concepts of how impedance is measured;
- Proper selection of experimental parameters;
- Graphical representation of impedance data, including methods to extract some physically meaningful parameters;
- Constant-phase elements;
- Application of electrical circuit analogues; and
- The meaning of the Kramers-Kronig relations.

The concepts will be illustrated by applications to different systems including corrosion, fuel cells, batteries, and transport through membranes such as skin. A list of suggested references will be provided.

This course is the first in a two course sequence offered at alternating ECS meetings by Professor Orazem. The second course in the series, "Advanced Impedance Spectroscopy," introduces model development based on proposed reaction mechanisms, statistical analysis of impedance data, and regression analysis.

Short Course #4

MEMS Reliability and Packaging
Slobodan Petrovic, Instructor

This course provides a comprehensive overview of a broad array of MEMS packaging and reliability issues. While some prior knowledge by the participants of MEMS in general is helpful, the packaging discussion will require a fairly detailed explanation of the principles of operation, fabrication methods, and materials used in building MEMS structures. The course is therefore open to participants with no prior MEMS knowledge and would provide a reasonably broad general introduction into the field. Because each MEMS design deserves its own distinctive packaging approach, packaging considerations will be, whenever possible, illustrated using specific device examples; and every opportunity will be used to demonstrate the uniqueness of a packaging solution and its interaction with a micromachined structure. Using this dynamic teaching method, in addition to learning in depth about packaging and reliability, the participants will have the opportunity to gain knowledge about MEMS in general through the eyes of a packaging and reliability specialist.

A broad range of MEMS devices will be discussed while a particular emphasis will be placed on sensors and actuators used in industrial, medical, and automotive applications. Extensive case studies that will be used to most effectively demonstrate diverse packaging principles for devices such as accelerometers, pressure sensors, and digital micromirror devices.

The course will be divided in 2 major sections: general MEMS competence; and packaging and reliability. The following major topics will be covered:

- Fabrication technologies
- Materials
- Design and device physics
- Main MEMS types
- Integration aspects
- Selected industrial application
- Design considerations
- Types of packaging
- Quality control
- Reliability
- Failure analysis

Short Course #5

Scientific Writing for Scientists and Engineers
Noel Buckley, Instructor

Do you sometimes have trouble explaining your results when you write a paper? Do reviewers often comment that your data and discussion is unclear? Do editors complain about your English usage? If so, then this is the course for you! In this course you will learn how to improve your scientific writing. You will learn how to write a paper that gets accepted more quickly! This course is intended for scientists and engineers with an interest in developing their skills in writing scientific documents including journal papers, conference proceedings papers, abstracts, reports, theses, and proposals. The course will be of particular interest to researchers and graduate students as well as to university faculty who want to improve

both their own writing and that of their students. It will address elements of good writing in science and engineering, including standard practices, terminology and formatting. It will teach attendees how to present information using properly structured sentences, paragraphs, sections, and chapters and how to organize experimental results and analysis in a format suitable for publication in the scientific literature as well as in reports, theses, etc. The topics to be covered include:

- How to communicate your message in clear, precise English;
- How to write effective sentences;
- How to structure paragraphs effectively;
- How to structure documents so that they are clear, effective and easy to read;
- How to be complete but concise;
- Standard writing practices and formatting;
- Effectively presenting your methods, results, discussion, and conclusions;
- Titles, tables, figures, captions and references;
- Standard practices for presenting scientific information;
- Appropriate level of detail;
- Mathematical descriptions, data, and units; and
- Grammar, punctuation, abbreviations, and acronyms.

Short Course #6

Advanced Microscopy Methods for Studying PEM Fuel Cell Materials

Karren L. More, Instructor

The µm- to sub-Å-scale structural and chemical characterization of fuel cell material constituents via advanced electron microscopy techniques plays an integral role in elucidating the critical material's degradation mechanisms contributing to fuel cell performance loss. Such techniques include atomic-scale imaging via aberration-corrected scanning transmission electron microscopy (STEM) coupled with the ability to resolve compositional/chemical changes at the atomic scale using energy dispersive spectroscopy (EDS) and/or electron energy loss spectroscopy (EELS). Recently, the development of specialized holders for conducting novel *in situ* microscopy experiments (such as liquid STEM, electrochemistry, gas-flow reactions, biasing, etc.) combined with high-resolution imaging and microanalysis has enhanced the ability to study critical structural changes to individual materials constituents comprising fuel cell membrane electrode assemblies under relevant environmental conditions.

The primary microscopy and spectroscopy techniques available today, which are used to study fuel cell materials, will be summarized and described in detail. Advanced methodologies for quantifying critical structural changes related to particular fuel cell testing protocols and materials degradation phenomena will be described and are supported with specific materials-specific characterization studies.

Corporate Tutorial

Intellectual Property: An Introduction for Research Scientists, Engineers, and Technologists

E. Jennings Taylor, Instructor

This half-day tutorial (1300-1600h) will provide an introduction to the various forms of intellectual property; trade secrets, trademarks, and copyrights with an emphasis on patents. The objective of the tutorial is to provide the electrochemist/engineer with an appreciation of the historical basis of the patent system and the nuances related to the concepts of prior art and obviousness. A case study of the on-going prosecution of an electrochemical technology will be presented. In addition, the Leahy-Smith America Invents Act, signed into law in September 2011, will be reviewed.

This tutorial will provide an introduction to the various forms of intellectual property, trade secrets, trademarks, and copyrights with an emphasis on patents. The foundation of modern patent principles will be traced from their origin in the U.S. Constitution, their early development and recent status. Topics to be covered include:

- Analogies between intellectual property and tangible property;
- Distinction between an author of a scientific paper and inventor on a patent; and
- Statutory criteria for obtaining a U.S. patent:
  - utility,
  - novelty,
  - non-obviousness,
  - enabling description; and
  - lack of prior public disclosure.

The tutorial will provide the basis for determination of novelty vis-à-vis prior art. In addition, the difference between "technical obviousness" and "legal obviousness" will be clarified. Finally, the nuances regarding public disclosure will be addressed. This tutorial will introduce the various forms of patent claims in view of claim elements and will culminate with case studies of the patent examination process along with the potential for citation analysis as a tool for identifying potential strategic partners. In closing, the purpose of the tutorial is not to replace the patent counsel, but rather to facilitate informed interaction between the scientist/engineer/technologist inventor with said patent.

Professional Development Workshops

The three professional development workshops—Writing an Effective Cover Letter and Resume, Job Interviewing Tips, and Resume Roundtable—are free to all technical meeting registrants, and are taught by John Susko, retired corporate executive. If you plan to attend the Resume Roundtable, please bring a copy of your current resume.

ECS Presents Its First-Ever Clean Water Technologies Symposium

Don't Miss This Important Full-Day Session!

Water is a critical environmental issue, one of the greatest problems facing the world today. For this vital natural resource to be available through the 21st century, new paradigms are needed for management, remediation, and valuation. With the emergence of novel sensing modalities and processing technologies, ECS has a unique opportunity to provide a forum for the presentation of original research and innovation that can impact the future direction of Clean Water Technologies and provide viable solutions for the current and future needs.

For more information contact: meetings@electrochem.org

Clean Water Technologies Symposia (A3)

Tuesday, May 8, 2012

Symposium Organizers: B. Stoner, Z. Aguilar, E. Greenbaum, P. M. Natishan, E. J. Taylor, and J. Weidner

- **Water Treatment and Sanitation**
  Co-Chairs: Brian Stoner and Elias Greenbaum
- **Water Treatment Technologies**
  Co-Chairs: Paul Natishan and E. Jennings Taylor
- **Water Treatment Systems and Applications**
  Co-Chairs: Brian Stoner and Paul Natishan

plus a

- **Clean Water Technologies Poster Session**

Meeting Events-at-a-Glance

Sunday, May 6

0900h Short Courses
1500h Writing an Effective Cover Letter and Resume Workshop
1600h Job Interviewing Tips Workshop
1730h ECS Student Mixer
1930h Sunday Evening Get-Together

Monday, May 7

0930h Coffee Break
1200h Writing an Effective Cover Letter and Resume Workshop
1215h Industrial Electrochemistry & Electrochemical Engineering Division Luncheon & Business Meeting; non-refundable ticketed event
1215h Physical & Analytical Electrochemistry Division Luncheon & Business Meeting; non-refundable ticketed event
1300h Job Interviewing Tips Workshop
1400h Resume Roundtable Workshop
1400h Society Award Lectures
1700h The 221st Meeting Lecture
1800h Monday Evening Mixer, Student Poster Session, Technical Exhibit Opening, & Career Fair

Tuesday, May 8

0900h Technical Exhibit & Career Fair
0930h Coffee Break
1215h Annual Society Luncheon & Business Meeting; non-refundable ticketed event
1630h *ECS Transactions* Tutorial Session for Authors
1800h Technical Exhibit, General Poster Session, & Career Fair

Wednesday, May 9

0900h Technical Exhibit
0930h Coffee Break
1215h Energy Technology Division Luncheon & Business Meeting; non-refundable ticketed event
1215h Fullerenes, Nanotubes & Carbon Nanostructures Division Luncheon & Business Meeting; non-refund
1215h Organic & Biological Electrochemistry Division Luncheon & Business Meeting; non-refundable ticketed event

Thursday, May 10

0930h Coffee Break

Registration Instructions

Complete ALL sections of the Registration Form located on the adjacent page or on the ECS website. Make check or money order payable to ECS. Payments must be made in U.S. funds drawn on a U.S. bank; MasterCard, Visa, American Express, or Discover are also accepted. All refunds are subject to a 10% processing fee. Written requests for refunds will be honored only if received at the ECS headquarters office by April 13, 2012.

Attendees prepaying by credit card may send their Registration forms to the ECS headquarters office by fax: 1.609.737.2743. If you send your Registration form by fax, please do not send another copy by mail, as this may result in duplicate charges. All registrations will be confirmed by e-mail.

A—Registration Fees

Meeting Abstracts are FREE. Registrants may easily access them through wireless Internet which will be available in the Washington State Convention Center, view them on the ECS Meeting App, or download them directly from the ECS website.

All prices are in U.S. dollars.

	April 7 (through May 10)
ECS Member	$520
Nonmember	$720
ECS Student Member	$255
Student Nonmember	$295
One Day ECS Member	$380
One Day Nonmember	$470
ECS Emeritus or Honorary Member	$0
Companion Registrant	$30

B—Sunday Short Courses

Deadline for Short Course registration is April 6, 2012. **Pre-registration is required. All courses are subject to cancellation pending an appropriate number of advance registrants.** The registration fee for Short Courses is $425 for ECS Members and $520 for nonmembers. Students are offered a 50% discount. Includes admittance to Sunday Short Courses ONLY; not applicable to any other meeting activities. The half-day Tutorial fee is $212.50 (members and nonmembers), and the student fee is $106.25. If you are an employee of an ECS Corporate Member, the fee is $25.

C—Luncheons & Special Events

Tickets are non-refundable because ECS is required to pay the venue for all tickets ordered.

	April 7 (through May 10)
Industrial Electrochemistry & Electrochemical Engineering Division Luncheon & Business Meeting	$32
Physical & Analytical Electrochemistry Division Luncheon & Business Meeting	$32

Tuesday (May 8)

Annual Society Luncheon & Business Meeting	$32

Wednesday (May 9)

The Dielectric Science & Technology Division Luncheon & Business Meeting has been cancelled.

Energy Technology Division Luncheon & Business Meeting	$32
Fullerenes, Nanotubes & Carbon Nanostructures Division Luncheon & Business Meeting	$32
Organic & Biological Electrochemistry Division Luncheon & Business Meeting	$32

SYMPOSIUM TOPICS

A — General Topics
- A1 — General Student Poster Session
- A2 — Tutorials in Nanotechnology: More than Moore – Beyond CMOS Emerging Materials and Devices HC e
- A3 — Clean Water Technologies (see p. 5 of this brochure)
- A4 — Nanotechnology General Session

B — Batteries, Fuel Cells, and Energy Conversion
- B1 — Batteries and Energy Technology Joint General Session
- B2 — Large Scale Electrical Energy Storage 1
- B3 — High Temperature Batteries
- B4 — Ionic and Mixed Conducting Ceramics 8 HC e
- B5 — Special Topics in Battery Science and Technology
- B6 — Tutorials on Electrocatalysis in Low Temperature Fuel Cells HC e
- B7 — Next Generation Portable Power

C — Biomedical Applications and Organic Electrochemistry
- C1 — Organic and Biological Electrochemistry General Poster Session
- C2 — 10th Manual M. Baizer Memorial Symposium on Organic Electrochemistry
- C3 — Progress in Fundamental and Applied Bioelectrochemistry
- C4 — New Synthetic and Mechanistic Approaches to Molecular Electroorganic Chemistry

D — Corrosion, Passivation, and Anodic Films
- D1 — Corrosion General Session

E — Dielectric and Semiconductor Materials, Devices, and Processing
- E1 — Dielectrics for Nanosystems 5: Materials Science, Processing, Reliability, and Manufacturing HC e
- E2 — Graphene, Ge/III-V, Nanowires, and Emerging Materials for Post-CMOS Applications 4 HC e
- E3 — Integrated Optoelectronics 6
- E4 — Nanoscale Luminescent Materials HC e
- E5 — DSilicon Compatible Materials, Processes, and Technologies for Advanced Integrated Circuits and Emerging Applications 2 HC e
- E6 — Thermal and Plasma CVD of Nanostructures and Their Applications
- E7 — Wide-Bandgap Semiconductor Materials and Devices 13 HC e

F — Electrochemical / Chemical Deposition and Etching
- F1 — Stress-Related Phenomena in Electrochemical Systems 2

G — Electrochemical Synthesis and Engineering
- G1 — Industrial Electrochemistry and Electrochemical Engineering General Session
- G2 — Multiscale Modeling of Electrochemical Systems 5
- G3 — Characterization of Porous Materials 5
- G4 — Electrochemical Engineering for the 21st Century 2
- G5 — Fuel Cell Membranes, Electrode Binders, and MEA Performance

H — Fullerenes, Nanotubes, and Carbon Nanostructures
- H1 — Electron Transfer and Energy Applications of Fullerenes and Nanostructured Materials
- H2 — Chemistry of Fullerenes and Carbon Nanotubes
- H3 — Carbon Nanotubes and Nanostructures: Fundamental Properties and Processes
- H4 — Carbon Nanotubes and Nanostructures: Applications and Devices
- H5 — Endofullerenes and Carbon Nanocapsules
- H6 — Carbon Nanotubes and Nanostrucutes: Medince and Biology
- H7 — Porphyrins and Supramolecular Assemblies
- H8 — Nanostructures for Energy Conversion
- H9 — Chemistry and Physics of Graphene and 2D Nanostructures

I — Physical and Analytical Electrochemistry
- I1 — Physical and Analytical Electrochemistry General Session
- I2 — Biological Fuel Cells 5
- I3 — Electroanalytical Chemistry Applied to Biomedical Applications
- I4 — Electrocatalysis Applied to Fuel Cells and Electrolyzers
- I5 — Exploiting Magnets in Electrochemistry
- I6 — Fundamental Aspects of the Electrochemical and Interfacial Properties of Carbon Nanostructures
- I7 — Recent Advances in Spectro-Electrochemistry
- I8 — Electrochemical Impedance Spectroscopy: Modeling and Interpretation

J — Sensors and Displays: Principles, Materials, and Processing
- J1 — Sensors, Actuators, and Microsystems General Session
- J2 — Nano/Bio Sensors
- J3 — Sensors for Safety and Security

***ECS Transactions* (ECST) – Symposia with issues available "at" the meeting are labeled with the following icons:**

HC **Hard-cover (HC)** editions of *ECS Transactions* will be available for purchase and pick-up at the meeting; or you may pre-order your hard-cover ECST issue using the meeting registration form in this brochure or when registering online.

e **Electronic (PDF)** editions of *ECS Transactions* will be available ONLY via the ECS Digital Library (www.ecsdl.org). Electronic editions of the Seattle "at" meeting issues will be available for purchase beginning April 27, 2012. Please visit the ECS website for all issue pricing and ordering information for the electronic editions.

***ECS Transactions* – Forthcoming Issues**

In addition to those symposia that have committed to publishing an issue of *ECS Transactions*, all other symposia potentially will be publishing an issue of ECST approximately 16 weeks after the Seattle meeting. If you would like to receive information on any of these issues when they become available, please e-mail ecst@electrochem.org. Please include your name, e-mail address, and all issues in which you are interested.

Purchase a hardcover copy of *ECS Transactions* Volume 45, Issues 1, 2, 3, 4, 5, 6, or 7, with your Seattle meeting registration and receive 10% off that issue's list price! For ECS Members the 10% discount will be on top of your regular Member discount for these issues. Any discounted books purchased must be picked up at the Seattle meeting. The discount does not apply to electronic editions of these issues. This discount is not valid on any other issues of ECST, Monographs, or Proceedings Volumes purchased at the meeting.

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ECS is always looking for new ways to make our meeting information more accessible to all attendees and contribute to the sustainability of the planet. So, beginning in Seattle, Meeting Abstracts are always right at hand—and as always, are **FREE**. Registrants may easily access them through wireless Internet which will be available in the Washington State Convention Center, view them on the ECS Meeting App, or download them directly from the ECS website.

Registration Form

Seattle, WA—May 6-10, 2012

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B—Sunday Short Courses

Deadline for Short Course registration is April 6, 2012. ***Pre-registration is required****. All courses are subject to cancellation pending an appropriate number of Early-Bird registrants. All course prices are $425 for ECS Members and $520 for nonmembers. Students receive 50% discount on all course prices. The half-day Tutorial fee is $212.50 (members and nonmembers), and the student fee is $106.25. If you are an employee of an ECS Corporate Member, the fee is $25.*

1 — Enantioselective, Electrochemical Sensors: Design, Response Characteristics, and Applications . . . $_____
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C—Luncheons & Special Events

Write the number of tickets desired for each event on the corresponding line and enter the total amount for all tickets on Line C. ***Tickets are non-refundable.***

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Industrial Electrochemistry & Electrochemical Engineering Division Luncheon & Business Meeting . . . _____ $32

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D—Publications

The following issues of ECS Transactions *will be published from symposia held during the Seattle meeting and will be available for pick-up at the meeting. Discount prices shown are for ECS Members (M) and Nonmembers (NM). Please see the Symposium Topics section of this brochure for details about the discounted prices.* ***Electronic (PDF)*** *editions of these issues are available for purchase beginning April 27, 2012, and ONLY by visiting the ECS Digital Library (www.ecsdl.org). Please visit the ECS website for all issue pricing and ordering information for the electronic editions.*

(Please see the Symposium Topics page for a list of all issues that will be available after the meeting)

HC *Hard-cover*		List Price	Member Discounted Price	Nonmember Discounted Price
HC Vol. 45 No. 1	**Ionic and Mixed Conducting Ceramics 8** *Editors: M. Mogensen, et al.*	____ ~~$179~~	____ $125	____ $161
HC Vol. 45 No. 2	**Tutorials on Electrocatalysis in Low Temperature Fuel Cells** *Editors: T. Zawodzinski, et al.*	____ ~~$115~~	____ $81	____ $104
HC Vol 45 No. 3	**Dielectrics for Nanosystems 5: Materials Science, Processing, Reliability, and Manufacturing -and- Tutorials in Nanotechnology: More than Moore – Beyond CMOS Emerging Materials and Devices** *Editors: D. Misra, et al.*	____ ~~$177~~	____ $124	____ $159
HC Vol 45 No. 4	**Graphene, Ge/III-V, Nanowires, and Emerging Materials for Post-CMOS Applications 4** *Editors: Y. Obeng, et al.*	____ ~~$115~~	____ $81	____ $104
HC Vol 45 No. 5	**Nanoscale Luminescent Materials 2** *Editors: D. Lockwood, et al.*	____ ~~$115~~	____ $81	____ $104
HC Vol 45 No. 6	**Silicon Compatible Materials, Processes, and Technologies for Advanced Integrated Circuits and Emerging Applications 2** *Editors: F. Roozeboom, et al.*	____ ~~$115~~	____ $81	____ $104
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