Special Meeting Section

223rd ECS Meeting • May 12-16, 2013 • Toronto, ON, Canada

Welcome to Toronto! We are pleased to be back in this exciting city for the 223rd ECS Meeting. This major international conference will be held at the Sheraton Centre Toronto Hotel and will include 45 topical symposia consisting of 1,514 technical presentations. You are invited to participate in the technical program as well as many other social events planned for the meeting.

Featured Speakers

Plenary Session and The ECS Lecture

The Frontier of Electronics Research

by Michael Mayberry

Monday, May 13
1700h
Grand Ballroom East

The current era of semiconductor research is heavily dependent on the incorporation of new materials into structures measured in nanometers. For the next decade, these trends are expected to continue and will suffice to improve the traditional metrics of performance-power and costs. Nevertheless there are inflection points coming, both for technology and for products, which will require advanced research to deliver solutions in time. Traditional computation is morphing and novel technologies under investigation will require a more interdisciplinary approach. There are many choices to be made but a rich future lies ahead of us.

Michael C. Mayberry is Director of Components Research, which is the research arm for the Technology and Manufacturing Group of Intel. He is responsible for ongoing research to enable future process options for Intel's technology development organizations. This scope includes internal research, external university research, and other external collaborations.

Since joining Intel in 1984 as a process integration engineer, Mayberry has held a variety of positions. As part of the California Technology Development team, he developed EPROM, flash, and logic wafer fabrication processes. In 1994 he moved to Sort Test Technology Development, most recently as Director, responsible for roadmaps and development of test processes for Intel microprocessors. In 2005, he moved to Components Research.

Mayberry received his PhD in physical chemistry from the University of California, Berkeley in 1983 and his Bachelor's degree in chemistry and mathematics from Midland College in 1978.

2013 ECS Gordon E. Moore Medal for Outstanding Achievement in Solid State Science and Technology Award Lecture

Wide Bandgap Semiconductors for Sensing Applications

by Fan Ren

Monday, May 13
1400h
Grand Ballroom East

The biosensor market is forecasted to reach $4.4 billion by 2014 in the U.S. This growth will be sustained especially by a high demand for biosensors that can be used for medical applications such as glucose monitoring, biomarker detection for infectious diseases, and cancer diagnosis. In addition, there will be strong demand for biosensors with applications in biodefense, environmental monitoring, food, and pharmaceutical industries. There is currently great interest in developing sensors that could be used in point-of-care applications or on-field measurements to reduce medical costs and emergency room visits. Transistor based sensors are promising for these applications. These sensors need

to have high precision, compact size, fast response time, and be sensitive to small amounts of biological material.

Semiconductor properties include current, potential, and impedance characteristics that can be used to directly measure chemical or physical stimuli on the semiconductor surface. The wide energy bandgap semiconductor gallium nitride (GaN) material system is attracting much interest for commercial applications of green, blue, and UV light emitting diodes (LEDs), laser diodes, as well as high speed and high frequency power devices. Due to the wide-bandgap nature of the material (3.2 eV for GaN as compared to 1.12 eV for Si), it is very thermally stable, and electronic devices can be operated at temperatures up to 500ºC. The GaN based materials are also chemically stable, and no known wet chemical etchant can etch these materials; this makes them very suitable for operation in chemically harsh environments. GaN based sensors for gas and chemical detection as well as medical applications will be presented.

Fan Ren received a BS degree in applied chemistry from Feng Chia University in 1975; an MS degree in chemical engineering from National Cheng Kung University in 1978, an MS degree in polymer science and engineering, and a PhD in inorganic chemistry from Brooklyn Polytechnic in 1991. He joined the University of Florida (UF) in 1998 where he is a Distinguished Professor in the Department of Chemical Engineering and an ExxonMobil Gator Chemical Engineering Alumni Chair Professor. Prior to joining UF, Ren worked at Bell Labs where he was a key figure in developing GaAs metal semiconductor field effect transistors grown on silicon substrate, carbon-doped InGaP/GaAs heterojunction bipolar transistors, and enhancement mode GaAs and InGaAs metal oxide semiconductor (MOS) field effect transistors. At UF, Dr. Ren has primarily focused on fabrication processes for high breakdown voltage GaN based Schottky and MOS diodes, as well as AlGaN/GaN high electron mobility transistor based sensors.

Dr. Ren's publications have been cited over 13,500 times in the literature. He is a Fellow of ECS, APS, AVS, IEEE, MRS, and SPIE. He is the co-author of more than 820 journal publications and co-inventor of 31 issued patents. He received the 2008 Electronics and Photonics Division Award from ECS, the 2010 Albert Nerken Award from AVS, and the 2010 NASA Tech Brief Initial Award.

Short Courses and Workshops

Four Short Courses will be offered in Toronto. These courses will be held on Sunday, May 12, 2013, from 0900h to 1630h. The registration fee for the Short Courses is $425 for ECS Members and $520 for nonmembers. Students are offered a 50% discount: $212.50 for ECS Student Members and $260 for Nonmember Students. The registration fee for the course covers the course, text materials, continental breakfast, luncheon, and refreshment breaks; **it does not cover the meeting registration**, and it is not applicable to any other activities of the meeting.

The deadline for registration for a course is April 12, 2013. Pre-registration is required for the Short Courses. You may register using the Early-Bird Registration Form on the ECS website. Written requests for Short Course refunds will be honored only if received at ECS headquarters by April 19, 2013. All refunds are subject to a 10% processing fee and requests for refunds must be made in writing and e-mailed to, customer.service@electrochem.org. Refunds will not be processed until AFTER the meeting. All courses are subject to cancellation pending an appropriate number of advance registrants. **Before making any flight or hotel reservations, please check to make sure the course is running!**

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

Short Course #1

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:

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

Short Course #2

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.

Short Course #3

Fundamentals of Electrochemistry: Basic Theory and Thermodynamic Methods

Jamie Noël, Instructor

This course covers the basic theory and application of electrochemical science. It is targeted toward people with a physical sciences or engineering 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 work that they are doing. The topics to be covered include:

1. Introduction and Overview of Electrode Processes
2. Chemical vs. Electrochemical Thermodynamics
   - reference electrodes, standard potentials, cell potentials, Nernst equations, electrode-solution interfaces, and double-layer structures
   - ion-selective electrodes, applications in analytical electrochemistry and sensors, aqueous and non-aqueous systems
3. Chemical Stoichiometry vs. Faraday's Law
   - coulometry, bulk electrolysis
4. Theoretical Basis for Methods
   - surface tension, adsorption and adsorption isotherms, electrocapillarity, potential of zero charge, Lippmann equations
5. Methodology
   - potentiometry, differential capacity, coulometry, cyclic voltammetry, polarography
6. Electrochemical Instrumentation
   - voltmeters, ammeters, potentiostats, galvanostats, design of electrochemical cells
7. Coupled Characterization Methods (time permitting)
   - modified electrodes, spectroelectrochemistry, *in situ* neutron scattering, surface analysis, etc.

Short Course #4

Atomic Force Microscopy for Energy Research Applications & Electrochemistry
Keith Jones, Instructor

This course is intended for chemists, physicists, and materials scientists that want to understand how Atomic Force Microscopy (AFM) can be used to characterize materials and to probe electrochemical processes and ionic transport in solids for a broad range of applications for energy generation and storage ranging from batteries to fuel cells. A new technique called Electrochemical Strain Microscopy (ESM) will be introduced. ESM, developed by Oak Ridge National Laboratory, is an innovative new AFM/SPM technique that is capable of probing electrochemical reactivity and ionic flows in solids on the sub-ten-nanometer level. Students will learn the science behind the technique, how it works, and the advantages of this technique over other methods. Current ESM results will also be presented and general AFM tips and tricks for electrochemistry applications.

- Introduction to AFM
- Instrumentation and scanning modes
- Challenges in battery/energy research characterization
- Introduction to the ESM technique
- Advantages of the technique over others
- Current research and image examples
- Tips and tricks for AFM electrochemistry measurements

Professional Development Workshops

The following are available at no additional cost; but space is limited, so please arrive early!

John R. Susko, Instructor

Several key professional development workshops will be presented May 13-15, 2013. These important workshops will provide attendees with up-to-date information on enhancing career opportunities and growth and are a great lead into the Career Fair. The professional development workshops are open to all registered attendees at no additional cost.

Professional Development Series – Essential Elements for Employment Success: Landing your next job requires selective and effective networking, developing and submitting specifically targeted resumes and cover letters, locating relevant job opportunities and preparing for and participating in the job interview. This workshop will provide up-to-date information and tips for employment success.

Monday..... 1230-1430h
Tuesday 1230-1430h

Professional Development Series – Résumé Review: At a loss for words? Bring your résumé for a one-on-one session with an industry leader and expert on résumé development. You will walk away with a résumé that is sure to land you your next interview.

Tuesday 0800-1200h
Wednesday..... 0800-1200h

ECS Career Fair

Sponsored by Redcat™, the ECS Career Fair is a great way to connect with potential employees at every level of experience—from veterans in the science to newcomers entering research, development, and academia—and one of the most effective ways to recruit qualified candidates from the 223rd ECS Meeting.

With the purchase of any exhibit booth, your organization automatically has the opportunity to participate in the ECS Career Fair. Career Fair participants will receive two customized Career Fair booth signs, additional advertising on the ECS website, and a listing in the meeting program and our newly-designed mobile app. Plus, your organization will receive one free job posting on Redcat™ (redcatresearch.org), the online community created for everyone in electrochemistry and solid state science and technology. ECS will also have a Career Fair Board, located in the exhibit hall, where you can post available jobs onsite on a complimentary basis.

The Career Fair will take place during Exhibit hours, Tuesday-Thursday during the meeting.

Pre-registration by exhibitors is required to participate in the ECS Career Fair—space is limited. For more information about how your organization can take advantage of these opportunities please contact David Harkness at david.harkness@electrochem.org or visit http://www.electrochem.org/meetings/career_fair/. The Career Fair is open to all attendees.

Award Winners

NOTE: *For complete biographies of the award recipients, and the schedule of their presentations, please see the General Meeting Program on the ECS website: www.electrochem.org/meetings/biannual/223/223.htm.*

Dielectric Science & Technology Division Thomas D. Callinan Award and the Electronics and Photonics Division Award

Durgamadhab (Durga) Misra, professor and Associate Chair for Graduate Programs in the Department of Electrical and Computer Engineering at New Jersey Inst of Technology (NJIT), has contributed significantly to research in low power MOSFETs, especially in the field of gate dielectric reliability. His recent work on high-k gate stack reliability, especially the contribution of various layers to the entire gate stack breakdown, received considerable recognition. He is an ECS Fellow.

Dr. Misra has edited and co-edited more than 30 books and conference proceedings, authored more than 250 publications in peer-reviewed journals and international conference proceedings, and delivered more than 30 invited talks worldwide. He served as an Associate Editor of *IEEE Circuits and Devices Magazine* and on the advisory boards of *Interface* magazine and *ECS Transactions*. He is on the program committee of many nanoelectronic conferences and served as track chair of the IC Technology Division of the IEEE International VLSI Design Conference. He received the Distinguished Lecturer Award in 2010 from IEEE Electron Devices Society. He served as the Director of Microelectronics Research Center at NJIT and as visiting professor at Bell Laboratories.

Dr. Misra is also an advisor and mentor to many graduate and undergraduate students. He has graduated ten PhD students, 40 MS students, and more than 50 undergraduate students. In 2005 he received NJIT's Excellence in Teaching Award for demonstrating excellence in the classroom and for encouraging and guiding students to work at their highest academic level.

Dr. Misra received his MASc and PhD degrees in electrical engineering from the University of Waterloo, Canada in 1985 and 1988 respectively. He also has an MTech in solid state materials from the Indian Institute of Technology, New Delhi.

Energy Technology Division Research Award

Piotr Zelenay received his PhD and DSc ("habilitation") degrees in chemistry from Warsaw University, Warsaw, Poland. He was a postdoctoral research fellow at Texas A&M University, College Station (1983-1986), a visiting professor at the University of Illinois Urbana-Champaign (1988, 1989, 1990-92), University of Alicante, Spain (1994), and Colorado State University (1996-1997). Dr. Zelenay was appointed a faculty member in the Department of Chemistry, Warsaw University in 1983 and remained at the University until 1997, when he accepted permanent research position with Los Alamos National Laboratory (LANL). He has been associated with Materials Physics and Applications Division (formerly Materials Science and Technology Division) at Los Alamos National Laboratory for the past 15 years. He is currently a Project Leader and Team Leader at LANL focusing primarily on fundamental and applied aspects of polymer electrolyte fuel cell science and technology, electrocatalysis, and electrode kinetics.

Dr. Zelenay has published more than 100 research articles in renowned scientific journals, including *Nature* and *Science*, co-authored nearly 300 presentations, of which approximately 100 have been invited/keynote/plenary lectures. To his credit, Dr. Zelenay has 16 patents and patent applications in the area of polymer electrolyte fuel cells. Since becoming Project Leader for LANL Fuel Cell Program in 2000, Dr. Zelenay has led numerous research projects and received more than 20 awards and other recognition. Among others, in June 2010, he was awarded the DOE Hydrogen Program R&D Award in Recognition of Outstanding Contributions to Fuel Cell Technologies for research on non-precious metal electrocatalysts for oxygen reduction reaction. Dr. Zelenay is a member of ECS, International Society of Electrochemistry, and on the Editorial Board of *Electrocatalysis*.

Srinivasan Young Investigator Award of the Energy Technology Division

Stefan Freunberger studied chemistry at Vienna University of Technology, Austria. His general research interest is fundamental science in electrochemical energy storage and conversion, both with theoretical and experimental approaches. For his master's and PhD thesis, he moved to the Swiss Federal Institute of Technology (ETH) Zurich and the Paul Scherrer Institute, Switzerland. The work, under the guidance of Alexander Wokaun and Felix Büchi, was on polymer electrolyte fuel cells. To investigate transport processes on a wide range of relevant scales, he developed advanced models and novel experimental techniques, *e.g.*, the first method to measure resistance and current density with sub-mm resolution. Part of the modeling efforts were completed with Ned Djilali at the University of Victoria, Canada.

For postdoctoral work, he joined the group of Peter G. Bruce, FRS, at the University of St. Andrews, Scotland, to work on fundamental aspects of the nonaqueous LiO_2 battery. For this work he earned a EPSRC early career fellowship. His contributions to this rapidly evolving field embrace the development of *in situ* spectroscopic techniques, elucidation of the reaction mechanism, electrocatalysis and the important role of electrolyte and electrode substrate. He is author of over 27 peer reviewed publications, including in *Science* and *Nature Materials*, furthermore four patents and two book chapters. His work was presented in numerous lectures at major conferences, many of which were invited. Dr. Freunberger now builds his own research group at Graz University of Technology, Austria.

Fullerenes, Nanotubes, and Carbon Nanostructures Division Richard E. Smalley Research Award

Nazario Martín is a full professor of organic chemistry at the University Complutense of Madrid and Vice-Director of the Institute for Advanced Studies in Nanoscience of Madrid (IMDEA-Nanoscience). Recently he has been appointed as Dr.h.c. by La Havana University. Professor Martín's research interests span a range of targets with emphasis on the molecular and supramolecular chemistry of carbon nanostructures such as fullerenes, carbon nanotubes, and graphenes, π-conjugated systems as molecular wires and electroactive molecules, in the context of electron transfer processes, photovoltaics applications, and nanoscience. He has published over 420 papers in peer reviewed journals, given over 260 lectures in scientific meetings and research institutions, and supervised 25 theses. He has co-edited six books related with carbon nanostructures and he has been invited as guest editor for eight special issues in well-known international journals.

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Professor Martín has been visiting professor at UCSB and UCLA (California, USA) and Angers and Strasbourg (France) universities. He has served as a member of the Editorial Board of *Chemical Communications*, and he has served as General Editor of the Spanish journal *Anales de Química* (2000-2005) and as a member of the International Editorial Advisory Board of *The Journal of Materials Chemistry* (2000-2006). He is currently the Regional Editor for Europe of the journal *Fullerenes, Nanotubes, and Carbon Nanostructures* and a member of the International Advisory Board of *The Journal of Organic Chemistry* (ACS), *ChemSusChem* (Wiley-VCH), *ChemPlusChem* (Wiley-VCH), *Chemical Society Reviews* (RSC), and *Chemical Communications* (RSC). He is a member of the Royal Academy of Doctors of Spain as well as a Fellow of The Royal Society of Chemistry. In 2006-2012 he was the President of the Spanish Royal Society of Chemistry. He was the recipient of the Dupont Prize of Science in 2007; and the Gold Medal and Research Award in 2012, the highest distinction given by the Spanish Royal Society of Chemistry. He recently received the national Jaime I Award for Basic Research 2012. He is the last chemist distinguished with the EuCheMS Lecture Award in 2012.

Industrial Electrochemistry & Electrochemical Engineering Division New Electrochemical Technology (NET) Award

UTC Power is a proven leader in designing, manufacturing, and deploying fuel cells that generate clean and reliable power for buildings and transportation applications. The company, with more than 50 years of experience, is based in South Windsor, Connecticut, where it conducts research, development, and manufacturing of transportation and stationary fuel cells. UTC Power is the only fuel cell company in the world to have worked with all five major fuel cell technologies and to produce fuel cells for both stationary and transportation applications.

A team of six engineers from UTC Power are awarded the 2012 New Electrochemical Technology (NET) award for outstanding work in electrochemistry and electrochemical engineering that has enabled fuel-cell powered vehicles to achieve commercial levels of reliability and durability in real-world transit bus service. The team, with the assistance of many others at UTC Power, has systematically identified the physiochemical mechanisms that substantially impact the durability of Polymer Electrolyte Fuel Cells (PEFCs), developed and validated associated mathematical models and accelerated test protocols, and successfully implemented multiple decay-mitigation technologies into UTC Power's fleet of PEFC-based power plants in transit bus applications to achieve world-record performance. The fleet leader with the UTC Power designed and manufactured PureMotion® 120 fuel cell powerplant has run for over 12,000 operating hours in real-world service with original cell stacks and no cell replacements. The PureMotion® has also consistently maintained 90% fleet average availability over the past three years while concurrently improving miles between road calls from 6,000 to more than 15,000 miles on the original fleet of six buses.

Robert M. Darling is an authority in the area of electrochemical modeling. He has published over 60 papers and patents in areas ranging from basic electrochemical engineering to electrochemical power sources. Dr. Darling's modeling work in the area of platinum dissolution and carbon corrosion were key contributors to understanding transient durability of PEM fuel cells.

Sathya Motupally is the head of fuel cell R&D at UTC Power and is a world expert in the area of fuel cell design and components. He has published over 50 papers and patents in the area of fuel cells and batteries. Dr. Motupally was responsible for the development of next generation cell stack materials with improved durability and performance.

Timothy W. Patterson is a world expert in failure mode analysis with over 15 years of experience in the area of fuel cells. When the alpha design of the PureMotion® 120 was failing in less than 2,000 hours, Mr. Patterson led a Root Cause team that systematically identified the impact of operating conditions and component design on durability. The results of Mr. Patterson's work led to a key piece of intellectual property critical to the proper operation of PEM fuel cells.

Tom Skiba is a fuel cell component engineer with over 15 years of fuel cell design and test experience. Mr. Skiba was responsible for the development of accelerated test protocols to screen components for PEM fuel cells. Mr. Skiba's efforts also led to the verification of a suite of mathematical models that have proven invaluable for next generation designs.

Michael L. Perry is renowned for his work in the area of fuel cell degradation mechanisms. He was a part of the team that discovered the reverse-current mechanism during the start/stop of transportation fuel cells. Mr. Perry's work has ranged from carbon corrosion, platinum dissolution, to contamination.

Mathew P. Wilson is the lead Systems Engineer on the PureMotion® series of products. He was responsible for the incorporation of several durability-advancing technologies into the PureMotion® Model 120 system. The cyclic durability and start/stop system technologies are a key reason for the world class durability of the UTC Power bus powerplant.

Physical and Analytical Division David C. Grahame Award

Richard L. McCreery is currently Professor of Chemistry at the University of Alberta (UofA), with a joint appointment as a Senior Research Officer at the National Institute for Nanotechnology (NINT). Until 2006, he was Dow Professor of Chemistry at the Ohio State University. He received his BS in chemistry from the University of California, Riverside, in 1970, and PhD under Ralph Adams at the University of Kansas in 1974. His research involves spectroscopic probes of electrochemical processes, the electronic and electrochemical properties of carbon materials, and carbon-based molecular electronics. Much of his research involves collaborations with materials scientists and engineers, as well as surface scientists

and electrochemists. He leads an effort at NINT and UofA to investigate hybrid devices for molecular electronics, which combine existing CMOS technology with new electronic and optoelectronic devices containing active molecular components. McCreery has written over 200 refereed publications, including one book and ten U.S. patents, with three of those extended to Europe and Japan.

Europe Section Allesandro Volta Medal

Jean-Noël Chazalviel received his education in solid state physics. In 1976, his thesis work on the "spin-dependent Hall effect" was awarded the bronze medal of the CNRS Physics Department. After a postdoc stay at Bell Labs, he settled at CNRS-Ecole Polytechnique and switched to semiconductor electrochemistry. He addressed the ubiquitous surface or interfacial states, formulating an important model of electron transfer via surface states. He subsequently developed *in situ* infrared spectroscopy and became a leading expert of using this technique at semiconductor electrodes.

In 1989 Dr. Chazalviel established that during anodic dissolution in HF, the silicon surface remains hydrogenated and fluoride-free. His subsequent studies of the silicon/fluoride system led him to elaborating porous silica. His contributions to the spectacular field of porous silicon include a detailed theoretical model of the formation of porous semiconductors. These studies prompted him to undertake silicon surface modification by organic grafting. He was among the pioneers of this domain, which has since blossomed into a very active field.

Dr. Chazalviel also re-addressed the problem of the generation of ramified metal electrodeposits, and formulated a model explaining the instability of the deposition, based on an analytical/numerical approach and providing quantitative predictions subsequently verified by experiment.

In recognition of his achievements, Dr. Chazalviel was awarded several distinctions: the silver medal of the CNRS Chemistry Department (1994), the Ancel Prize of the French Physics Society (1994), and the Ivan Peychès Prize of the French Academy of Sciences (2006). His electrochemical studies have benefited from his strong background in physics and original ideas that often led him to designing novel techniques.

Technical Exhibit

The complimentary Technical Session coffee breaks are scheduled on Wednesday and Thursday at 0930h in the Exhibit Hall (Osgoode & Sheraton Ballroom, Lower Concourse Level). Gather with your colleagues, browse through exhibits, and chat with ECS Career Fair companies. The exhibit will feature instruments, materials, systems, publications, and software of interest to attendees.

Exhibit Hours

Tuesday, May 14 ..... 1300-1600h
Re-opening 1800-2000h
Includes the General & Student Poster Session

Wednesday, May 15 ..... 0900-1400h
Re-opening 1800-2000h
Includes the General Poster Session

Thursday, May 16 ..... 0900-1400h

Exhibitors as of Press-Time

ALS Co., Ltd.
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Symposium Topics and Organizers

A — General Topics

A0 — Special Lectures (M)

A1 — General Student Poster Session (Tu)-*Venkat Subramanian, Kalpathy B. Sundaram, and Vimal Chaitanya*

A2 — Nanotechnology General Session (M-Tu)-*F. Li, O. Leonte, and W. Mustain*

B — Batteries, Fuel Cells, and Energy Conversion

B1 — Energy Technology/Battery - Joint General Session(M-Th)-*A. Manthiram, A. Manivannan, and Sanjeev Mukerjee*

B2 — Battery Electrolytes(W-Th)-*F. Alamgir, W. Henderson, R. Jow, V. Thangadurai, Sanjeev Mukerjee, and P. Trulove*

B3 — Alkaline Electrochemical Systems for Energy Conversion and Fuel Production(Tu-W)-*S. R. Narayanan, Peter Pintauro, Bor Yann Liaw, Vijay Ramani, and P. Kulesza*

B4 — Design and Modeling of Battery Materials(Mo-Tu)-*J. T. Vaughey, Marina Yakovleva, and Ayakannu Manivannan*

B5 — Hydrogen Production, Conversion, and Storage 4 (Tu-W)-*Shirley Meng, Bor Yann Liaw, Scott Calabrese Barton, and Gerbrand Ceder*

B6 — Stationary and Large Scale Electrical Energy Storage 2(Tu)-*E. Fabbri, E. D. DiBartolomeo, F. Chen, and T. Norby* SC e

B7 — Nanoarchitectures for Energy Storage 1(M-W)-*J. Meyers, B. Y. Liaw, and Bob Savinell*

B8 — Next Generation of Supercapacitors (M-Tu)-*C. Johnson, Candace Chan, P. Atanasov, and Trung Van Nguyen*

B9 — Solar Fuels 2 (M-Tu)-*Prashant Kumta, Nick Wu, Mani Manivannan, Jeffrey Long, and Wenjing Zhang*

C — Biomedical Applications and Organic Electrochemistry

C1 — Innovations and New Directions in Organic Electrochemistry (W-Th)-*A. Fry and R. Mantz*

D — Corrosion, Passivation, and Anodic Films

D1 — Corrosion General Session (W-Th)-*R. S. Lillard*

D2 — Corrosion in Nuclear Energy Systems: From Cradle to Grave (M-Tu)-*R. S. Lillard, J. Noel, R. Newman, D Shoesmith, and S. Fujimoto*

E — Dielectric and Semiconductor Materials, Devices, and Processing

E1 — Bioelectronics, Biointerfaces, and Biomedical Applications 5 (Tu)-*D. Cliffel, Z. Aguilar, J. Burgess, A. Hoff, and A. Suroviec*

E2 — Graphene, Ge/III-V, and Emerging Materials for Post CMOS Applications 5 (M-W)-*D. Misra, S. Albin, Z. Karim, P. Srinivasan, Yaw Obeng, Stefan DeGendt, and Cor Claeys* HC e

E3 — Nanocrystal Embedded Dielectrics for Electronic and Photonic Devices (M-W)-*P. Mascher, Pooran Joshi, Mark E. Overberg, and Yue Kuo* SC e

E4 — Organic Semiconductor Materials, Devices, and Processing 4 (M-W)-*J. M. Deen, David Gundlach, B. Iniguez, and Hagen Klauk*

E5 — Silicon Compatible Materials, Processes, and Technologies for Advanced Integrated Circuits and Emerging Applications 3 (M-Tu)-*F. Roozeboom, E. P. Gusev, H. Iwai, S. J. Koester, D.-L. Kwong, M. Z. Ozturk, and P. I. Timans* SC e

E6 — Advanced Semiconductor-on-Insulator Technology and Related Physics 16 (M-Tu)-*Y. Omura, S. Cristoloveanu, F. Gamiz, amd B.-Y. Nguyen* SC e

E7 — Symposium on Processes at the Semiconductor Solution Interface 5 (W)-*Colm O'Dwyer, D. N.Buckley, A. Hillier, and Maria Salazar Villalpando* SC e

E9 — Wide-Bandgap Semiconductor Materials and Devices 14(Tu)-*Z. Mi, J. Bardwell, R.-H. Horng, G. W. Hunter, Z. Karim, C. O'Dwyer, and E. B. Stokes* HC e

F — Electrochemical / Chemical Deposition and Etching

F1 — Green Electrodeposition 3 (Tu)-*Sudipta Roy, G. Zangari, D. Barkey, and S. Yoshihara*

F2 — Novel Design and Electrodeposition Modalitie (W)-*E. Podlaha, S. Djokic, and L. Magagnin*

G — Electrochemical Synthesis and Engineering

G1 — Advances in Low Temperature Electrolyzer and Fuel Cell Technology: In Honor of Anthony B. (Tony) LaConti (Tu)-*John Staser, Cortney Mittelsteadt, Vijay Ramani, Peter Pintauro, and Brian Pivovar*

G3 — Electrochemical Engineering for the 21st Century: 3 (W)-*James Fenton, Venkat Subramanian, Richard Alkire, H. Deligianni, and John Harb*

G4 — Tutorials in Electrochemical Technology: Impedance Spectroscopy (Tu)-*Mark Orazem and Vincent Vivier*

H — Fullerenes, Nanotubes, and Carbon Nanostructures

H1 — Tutorials in Nanotechnology (Su)-*F. D'Souza*

H2 — Fullerenes - Chemical Functionalization, Electron Transfer, and Theory (W-Th)-*F. D'Souza, S. Fukuzumi, D. M. Guldi, N. Martin, J. F. Nierengarten, and V. R. Subramanian*

H3 — Endofullerenes and Metallofullerenes (Tu-W)-*T. Akasaka, A. Balch, and L. Echegoyen*

H4 — Carbon Nanotubes-From Fundamental Processes to Devices(M-Th)-*S. Doorn, Y. Gogotsi, R. Martel, S. V. Rotkin, R. B. Weisman, and M. Zheng*

H5 — Fundamentals of Graphene Related Structures (Tu)-*H. Grebel, R. Haddon, and S. V. Rotkin*

H6 — Focus Session: Carbon Nanostructures in Energy Applications and Energy Storage (M, W)-*D. M. Guldi and Robert Kostecki*

H7 — Carbon Nanostructures in Medicine and Biology (Th)-*T. Da Ros, Z. Aguilar, A. Hirsch, A. Simonian, and L. Wilson*

H8 — Porphyrin and Supramolecular Assemblies (M-W)-*K. Kadish, R. Paolesse, and N. Soladie*

H9 — Nanostructures for Energy Conversion (W-Th)-*H. Imahori and P. V. Kamat*

I — Physical and Analytical Electrochemistry

I2 — Computational Chemistry (W-Th)-*Steve Paddison*

I3 — Ethanol Oxidation (Mo-Th)-*Pawel Kulesza and Sanjeev Mukerjee*

I4 — Grahame Award Symposium and Physical and Analytical Electrochemistry General Session (M-W)

I5 — Ion Conduction in Polymers (Tu)-*Tom Zawodinski, Andrew Herring, and Gao Liu*

I6 — State of the Art Tutorial on Membranes and MEAs for Low Temperature Fuel Cells (M)-*T. Zawodzinski, N. Garland, D. Jones, and K. Yamada*

J — Sensors and Displays: Principles, Materials, and Processing

J1 — Environmental, Water Quality, and Safety Monitorin (Tu)-*Gary Hunter, Bryan Chin, Petr Vanýsek, and Rangachary Mukundan*

J2 — Nano/Bio Sensors (M-Tu)-*Zoraida P. Aguilar, A. Simonian, Larry Nagahara, Ajit Khosla, and H. De Long*

J3 — Sensors, Actuators and Microsystems General Session (M-Tu)-*M. Carter, N. Wu, R. Mukundan, G. Hunter, and Z. Aguilar*

***ECS Transactions* (ECST) – Symposia with proceedings 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 when registering online.

SC **Softcover (SC)** editions of *ECS Transactions* will be available for purchase at the meeting and will be shipped to you after the meeting ends. Please visit ECS Central in Toronto to order your softcover ECST issue.

e **Electronic (PDF)** editions of *ECS Transactions* will be available ONLY via the ECS Digital Library (www.ecsdl.org). Electronic editions of the Toronto "at" meeting issues will be available for purchase beginning May 3, 2013. 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 Toronto 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 53, Issues 1 or 2 with your Toronto 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 Toronto 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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Event Highlights

Note: *For a list of Committee Meetings, please visit the Toronto meeting page: www.electrochem.org/meetings/biannual/223.*

Sunday, May 12

0900h.....Short Courses
1400h.....Technical Sessions
1730h.....Student Mixer (invitation only; contact meetings@electrochem.org for details)

Please note, the Sunday Evening Get Together has been rescheduled to Monday at 1800h and is now called the Opening Reception.

Monday, May 13

0800h.....Technical Sessions
0930h.....Technical Session Coffee Break
1230h.....Professional Development Series: Essential Elements for Employment Success
1400h.....2013 ECS Gordon E. Moore Medal for Outstanding Achievement in Solid State Science and Technology Award Lecture: "Wide Bandgap Semiconductors for Sensing Applications," by Fan Ren
1700h.....The ECS Lecture: "The Frontier of Electronics Research," by Michael Mayberry
1800h.....Opening Reception (formally known as the Sunday Evening Get Together)

Tuesday, May 14

0800h.....Technical Sessions
0800h.....Professional Development Series: Resume Review
0930h.....Technical Session Coffee Break
1215h.....ECS Annual Business Meeting & Luncheon; non-refundable ticketed event
1230h.....Professional Development Series: Essential Elements for Employment Success
1300h.....Technical Exhibit
1300h.....Professional Development Series: Career Fair
1630h.....ECST Tutorial
1700h.....ECST Open Forum
1800h.....Technical Exhibit & General & Student Poster Session
1800h.....Professional Development Series: Career Fair

Wednesday, May 15

0800h.....Technical Sessions
0800h.....Professional Development Series: Resume Review
0900h.....Technical Exhibit
0900h.....Professional Development Series: Career Fair
0930h.....Technical Session Coffee Break located in the Exhibit Hall
1800h.....Student Poster Award Presentation in the Exhibit Hall
1800h.....Technical Exhibit & General Poster Session
1800h.....Professional Development Series: Career Fair

Thursday, May 16

0800h.....Technical Sessions
0900h.....Technical Exhibit
0900h.....Professional Development Series: Career Fair
0930h.....Technical Session Coffee Break located in the Exhibit Hall

Hotel & Travel Information

The 223rd ECS Meeting will be held at the Sheraton Centre Toronto Hotel (123 Queen Street West, Toronto, Ontario, M5H 2M9, Canada), the designated meeting headquarters. We strongly encourage you to stay at the Sheraton Centre Toronto Hotel, which offers the most convenient and enjoyable meeting experience. Reservations can be made online from the ECS website at a special discounted meeting rate starting at **$199 CAD** or **until the block sells out, whichever comes first**. See the ECS website for more details and to make your reservation.

The deadline for reservations is April 12, 2013. Reservations attempted after April 12 will be accepted on a space and rate availability basis.

Registration & General Meeting Information

Meeting Registration—The meeting registration area will be located in the Sheraton Centre Toronto Hotel, on the Concourse Level, one level directly below the main lobby. Registration will open on Saturday evening and the technical sessions will be conducted Sunday through Thursday.

Early-Bird Registration—**The deadline for Early-Bird registration is April 12, 2013.** Early-Bird registration is encouraged. Register online at www.electrochem.org or fax your registration form to 1.609.737.2743. Attendees pre-paying by credit card are encouraged to use our online system or send the form by fax. If you send a registration form by fax, please do not send another copy by mail, as this may result in duplicate charges. Refunds are subject to a 10% processing fee and will only be honored if written requests are received by April 29, 2013. Refunds will not be processed until AFTER the meeting. Regular registration rates are in effect online after April 12, 2013 and at the meeting. All meeting participants are required to pay the appropriate registration fees. Early-Bird and post-April 12 registration payments must be made in U.S. Dollars via Visa, MasterCard, American Express, Discover Card, check, or money order payable to ECS.

Nontechnical Registrant—Travel companions of Technical Registrants are invited to register for the 223rd ECS Meeting as a "Nontechnical Registrant." The nontechnical registrant registration fee of $25 (Early-Bird) or $30 (after April 12) includes admission to non-ticketed social events; an exclusive meet-up with beverage service and light refreshments, Monday through Thursday, 0800-1000h; and a special "Welcome to Toronto" orientation presented by Tourism Toronto on Monday, May 13th at 0900h in the Nontechnical Registrant Meet-up. Please note that online registration is not available for Nontechnical Registrants.

Key Locations in the Sheraton Centre Toronto Hotel

Meeting Registration.....Concourse Level
Information/Message Center.....Concourse Level
ECS Headquarters Office.....Wentworth Room, 2nd Floor
ECS Central.....Concourse Level
AV Tech Table.....Located outside select symposium rooms

Registration and ECS Central Hours

Saturday, May 11.....1700-1900h
Sunday, May 12.....0700-1900h
Monday, May 13.....0700-1900h
Tuesday, May 14.....0700-1730h
Wednesday, May 15.....0800-1600h
Thursday, May 16.....0800-1200h

***Registration Fees*—ALL PARTICIPANTS AND ATTENDEES ARE REQUIRED TO PAY THE APPROPRIATE REGISTRATION FEE LISTED BELOW**. Payment can be made by cash, check, or travelers' checks in U.S. funds drawn on a U.S. bank. Visa, MasterCard, American Express, or Discover are also accepted.

ECS Member	$450
ECS Student Member	$160
One Day ECS Member	$280
Nonmember	$620
Student Nonmember	$195
One Day Nonmember	$370

All students must present a current, dated student ID card, or for postdocs, a letter from a professor stating that you are a full or part-time student, when you pick up your registration materials at the meeting. Attendees who wish to have paper copies of abstracts in advance of the meeting should download copies from the ECS website, free of charge.

***Financial Assistance*—**Financial assistance is limited and generally governed by the symposium organizers. Individuals may inquire directly to the symposium organizers of the symposium in which they are presenting their paper to see if funding is available. Individuals requiring an official letter of invitation should write to the ECS headquarters office; such letters will not imply any financial responsibilities of ECS.

***ADA Accessibility*—**Special accommodations for disabled attendees will be handled on an individual basis provided that adequate notice is given to the ECS Headquarters Office.

***No Recording Allowed*—**Recording meetings events through audiovisual or photographic methods is prohibited at all official ECS Meeting events without written consent from ECS. The use of cameras is not permitted during technical sessions. Attendees or exhibitors may photograph their own activity, but permission must be obtained from all involved parties before photographs can be taken of other people or displays at the meeting or exposition. Press representatives must receive media credentials and recording permission from the ECS Headquarters Office.

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ecstransactions

Open Forum on the Future of *ECS Transactions*

In 2005, the distribution of ECS meeting content through ECS Proceedings Volumes (PVs) was replaced with the establishment of *ECS Transactions* (ECST). Currently, ECST includes full-text content that has been presented at ECS meetings and ECS-sponsored meetings, and the papers appearing in ECST are reviewed to ensure that submissions meet generally-accepted scientific standards. The types of papers presented in the two publications are similar, but ECST was created to take the PVs online (in the ECS Digital Library) and thus provide expanded features: accessibility, enhanced search capabilities, and linking to other ECS publications.

Changes in communication and information sharing technologies require that scientific publications continue to adapt to maintain effectiveness to meet the needs of authors and readers. ECS is evaluating opportunities for using ECST to expand distribution of ECS meeting technical content and promote scientific discourse among members of our community. To obtain author and user input and generate ideas, an open forum is scheduled at the ECS meeting in Toronto to discuss future opportunities for ECST.

Everyone is welcome to join ECST Editor Jeff Fergus and the ECS Publications staff for this first open forum.

Open Forum on the Future of *ECS Transactions*

Tuesday, May 14, 1700-1800
Conference Room G, Mezzanine Level
The Sheraton Centre Toronto Hotel

ECS Transactions Tutorial Session for Authors

Please join us for a special session about submitting your full-text manuscript of your Toronto presentation for publication in *ECS Transactions* (ECST), the online proceedings publication of ECS.

This session will cover how to prepare your manuscript, when and where to submit it, and how to navigate the manuscript submission website. All presenting authors are encouraged to attend this open session.

ECS Transactions Tutorial Session for Authors

Tuesday, May 14, 1630-1700
Conference Room G, Mezzanine Level
The Sheraton Centre Toronto Hotel