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# Boston

Massachusetts



## 220<sup>th</sup> ECS Meeting & Electrochemical Energy Summit

# Highlights

**B**oston was the site of many firsts for ECS: the largest attendance at an ECS meeting in continental North America (only PRiME has been larger), the first **Electrochemical Energy Summit**, the debut of **Redcat**,™ and the introduction of the **ECS mobile meeting app**.

Given the large attendance, symposia were well-attended and the all-meeting events, such as the Sunday Evening Get-Together and the Monday Evening Mixer, were buzzing with activity. The two evening events were particularly lively as people got a first look at Redcat (redcatresearch.org), the new research and professional networking site for everyone involved in electrochemistry and solid state science and technology. The essential tool for researchers, Redcat is the online destination for discovering cutting-edge research, connecting with peers, and sharing content and ideas. Visitors to the Redcat booths not only had the opportunity to see this powerful new research tool, but they also had a chance to win one of two Apple iPads. Robert Frankenthal and Chan Hyoung Kang were the lucky winners.

The new ECS Meeting app is available for both iOS and Android devices. Users of the app can locate symposia, special events, receive special announcements and last-minute schedule changes, and even communicate with other meeting attendees. The app, with some new features, will be available again for the ECS meeting in Seattle, May 6-11, 2012.

The ECS Corrosion Division was honored to have **Greta Uhlig**, widow of the late Herbert H. Uhlig, attend the annual Corrosion Division Business Luncheon, the Uhlig Award and Cohen Award lectures, and a reception for the Corrosion Division award winners at the meeting in Boston. While at the luncheon and reception, Mrs. Uhlig renewed old friendships with former associates of Dr. Uhlig as well as new and current members of the Corrosion Division. In addition, Mrs. Uhlig graciously donated to the Society Dr. Uhlig's Palladium Award Medal and his Acheson Award Medal. These items, as well as a First Edition of the *Uhlig's Corrosion Handbook*, were on display at the Corrosion Division Award Reception for everyone to admire and enjoy. Her visit brought together many Corrosion Division and Society members, all of whom made Mrs. Uhlig feel especially welcome, and a good time was had by all.

## Energy and Personal Transportation

In a break from the usual practice, and because of scheduling constraints imposed by the first-ever ECS Electrochemical Energy Summit, The ECS Lecture was scheduled on Sunday and was given by **Mark Verbrugge** of General Motors Corporation. Dr. Verbrugge is the Director of GM's Chemical Sciences and Materials Systems Laboratories. His group targets the advanced development of structural subsystems, energy storage devices, and various technologies associated with fuels, lubricants, and emissions. He is a Board Member of the U. S. Automotive Materials Partnership LLC and the U. S. Advanced Battery Consortium LLC. He also is an adjunct

professor in the Department of Physics at the University of Windsor in Ontario, Canada.

Dr. Verbrugge is a long-standing member of the ECS dating back to his graduate school days and has garnered a number of awards. These include both GM internal awards as well as recognition from the Society including the ECS Norman Hackerman Young Author Award (1990) and the ECS Energy Technology Division Award (1993). He won the Lifetime Achievement Award from the U. S. Council for Automotive Research in 2006 and was elected to the National Academy of Engineering in 2009.

Dr. Verbrugge was introduced to a packed audience by Esther Takeuchi, ECS President. He began his lecture with an historical discussion of the evolution of the automobile. He noted that many of the early designs of the 1950s were aggressively styled but not very energy efficient. Two shocks to the auto industry came in the form of the Ralph Nader's "unsafe at any speed" 1968 safety clarion call from the consumer side and the Arab oil embargo in 1972. The 1970s heralded major advancements in safety and emission features, but the 300,000 units/model featured rather pedestrian in styling and visual appeal. Then began an era of hyper-competition with many countries such as Japan and Korea jumping into the manufacturing fray. Dr. Verbrugge ended this talk segment raising the prospect of 1 billion vehicles in the near future (12 % growth rate). He wondered about the

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**KOJI HASHIMOTO** (right) received the 2011 ECS Olin Palladium Award from ECS President **ESTHER TAKEUCHI** (left) at the ECS meeting in Boston. The Olin Palladium Award was established in 1950 for distinguished contributions to the field of electrochemical or corrosion science.

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sustainability of the industry, particularly from an energy perspective, with cars using up about 96 % of the (dwindling) world petroleum output.

Dr. Verbrugge then turned to energy options for new-generation vehicles including electricity, liquid fuels such as compressed natural gas (CNG), and hydrogen. He noted the high energy density inherent in fuels such as ethanol and the advances being made in biofuels. Electric propulsion circumvents Carnot efficiency limitations inherent with the internal combustion engine design. The great progress made in recent years in energy savings such as the start-stop feature and consequent improvements in Pb acid battery and starter motor systems and regenerative braking were reviewed. Advancements in traction battery technology were noted as exemplified by the Chevy Volt extended range electric vehicle (EREV). Infrastructure aspects including (plug-in) battery charging options and innovations such as solar-powered charging stations were then discussed.

The final portion of the talk focused on trends and challenges in personal transportation, and it closed with a fascinating futuristic video on an electrified network vehicle (EN-V) concept designed to combat the global energy and environmental issues.



The ECS Lecture was delivered by **MARK VERBRUGGE**, Director of Chemical Sciences and Materials Systems Laboratory, General Motors.

## The Use of Renewable Energy in the Form of Methane via Electrolytic Hydrogen Generation

The Olin Palladium Award lecture, with the above title, was given by **Koji Hashimoto** on Monday. The awardee was introduced by past ECS President Barry MacDougall, who noted an illustrious list of past winners of this award that included names such as Wagner,

Evans, Frumkin, Uhlig, Levich, and Gerischer. Professor Hashimoto was recognized for his far-reaching contributions in the areas of corrosion-resistant amorphous electrode materials, electrodes for water electrolysis and catalysts for fuel production, and the role of nanostructure on corrosion resistance. Dr. Hashimoto designed and built a plant for hydrogen generation from seawater and the methanation of CO<sub>2</sub> with hydrogen. A prototype plant was built in 1995 and an industrial scale version was subsequently built in 2003, both at Tohoku Institute of Technology in Sendai, Japan.

Dr. Hashimoto's talk mainly focused on this technology. He began his award lecture by first thanking his many students who contributed to this work. The first part of the lecture was a perspective on global



ECS President **ESTHER TAKEUCHI** (back row, center) inducted the 2011 Class of ECS Fellows. Pictured in the front row (from left to right) are: **KARIM ZAGHIB**, **ARUMUGAM MANTHIRAM**, **PAUL TRULOVE**, and **HUGH DELONG**. In the back row (from left to right) are: **HUBERT GASTEIGER**, **GIOVANNI ZANGARI**, (President Takeuchi), **THOMAS ZAWODZINSKI**, and **ASHOK SHUKLA**. The award of ECS Fellow was established in 1989 to recognize individual contributions and leadership in the achievement of science and technology in the area of electrochemistry and solid-state sciences and current active participation in the affairs of ECS.



## The First Electrochemical Energy Summit

energy consumption in developed and developing countries. He projected that we would be devoid of oil by 2040, natural gas by 2046, uranium by 2048, and coal by 2054. He noted the plentiful solar flux and its applicability for power needs associated with seawater electrolysis.

Dr. Hashimoto then discussed his proposal for global CO<sub>2</sub> remediation and recycling consisting of several key components: power generation from solar cells in desert regions, hydrogen production from seawater electrolysis, and methane production by the reaction of this hydrogen with CO<sub>2</sub> at nearby desert coastal areas. The methane would supply energy from combustion and the generated CO<sub>2</sub> would be captured and recycled. The talk then turned to the materials aspects underpinning this proposed energy solution, particularly on cathode and anode development. The key to avoiding the incomplete methanation of CO<sub>2</sub> (leading to CO generation and electrode poisoning) lies in catalysis and the talk then focused on developments with catalyst supports consisting of ZrO<sub>2</sub>.

The fast-moving lecture finally closed with a status report of the current state of this technology and the economic challenges that remain in translating it to routine use.

The first Electrochemical Energy Summit (E2S) was convened on October 10-12, 2011. The objective of the first E2S was to initiate an international forum to discuss electrochemical means to address world-wide, societal energy needs. The Summit brought together researchers and policy makers from around the world for the

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*A view of the first ELECTROCHEMICAL ENERGY SUMMIT POSTER SESSION at the ECS meeting in Boston.*



*The first Electrochemical Energy Summit also included a lively panel discussion, moderated by Interface's own Krishnan Rajeshwar. In the front row (from left to right) are: panelist ERIC ISAACS, panelist and moderator KRISHNAN RAJESHWAR, Summit organizer JOHNA LEDDY, Summit organizer CHRISTINA BOCK, and panelist DETLEF STOLTEN. In the back row (from left to right) are: ECS Senior Vice-President TETSUYA OSAKA, panelist JOHN A. TURNER, ECS President ESTHER TAKEUCHI, panelist MARK VERBRUGGE; and panelist TATSUYA SHINKAWA.*



# electrochemical energy summit 2011

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exchange of questions about what are energy needs and answers of what electrochemical science and technology can provide to address societal needs. The assembled participants in the E2S indeed provided international representation of both questions and novel solutions in the field of electrochemical energy. Opportunities embedded in electrochemical energy and power systems, both thermodynamic and dynamic, are manifest. Thus, electrochemistry and electrochemical engineering are uniquely poised to provide effective and novel solutions to societal energy needs. Because electrochemical energy includes storage and generation, engineering and science, devices and fundamentals, as well as a wide variety of batteries, fuel cells, solar cells, photovoltaics, and supercapacitors, the strengths and expertise of ECS and its members provide the most appropriate venue for the Electrochemical Energy Summit.

Boston provided an excellent opportunity for the first E2S as the Boston meeting was the largest in North America and the third largest ECS meeting ever. There were over 3,000 attendees at the meeting and many at the E2S. Formal events at the E2S included the plenary lecture, a panel discussion on energy, and a multi-day poster session on electrochemical scientific and technological solutions to social energy challenges. Numerous opportunities for informal interactions were available.



John Wiley & Sons provided copies of the newest edition (the 5<sup>th</sup>) of *Modern Electroplating*, to be given away to two lucky winners at the Boston meeting. *Modern Electroplating*, the Society's first monograph, currently published by Wiley, is edited by Mordechai Schlesinger and Milan Paunovic. **ROB MANTZ** (left), one of the winners, received his autographed copy from **MORDECHAY SCHLESINGER** (far right). Looking on is **BOB ESPOSITO**, Associate Publisher with Wiley.



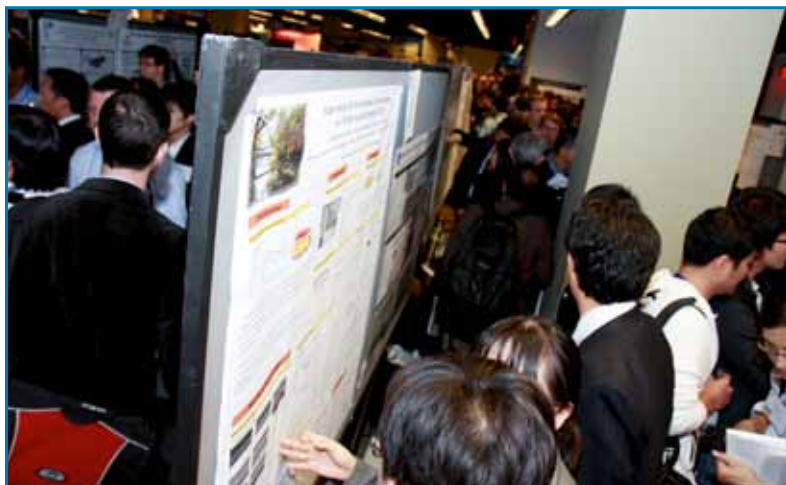
Each year the Society presents its Norman Hackerman Young Author Awards for the best papers from the Journal of The Electrochemical Society of the previous year. The winners for papers published in 2010 received their awards in Boston from ECS President **ESTHER TAKEUCHI** (center). In the category of Solid State Science & Technology, the winners were **STEPHEN E. POTTS** (right), **ERIK LANGEREIS** (not present), and **GIJS DINGEMANS** (left), for "Low Temperature Plasma-Enhanced Atomic Layer Deposition of Metal Oxide Thin Films" (Vol. 157, p. P66). Also not present in Boston was **XINGBAO ZHU**, who received the award in the category of Electrochemical Science & Technology, for "Performance of the Single-Chamber Solid Oxide Fuel Cell with a  $\text{La}_{0.75}\text{Sr}_{0.25}\text{Cr}_{0.5}\text{Mn}_{0.5}\text{O}_{3-\delta}$ -Based Perovskite Anode" (Vol. 157, p. B691).



**PHILIPPE ALLONGUE** (left) accepted the 2011 ECS Electrodeposition Division Research Award in Boston from **CHRISTIAN BONHÔTE** (right), Chair of the Division. After receiving the award, Dr. Allongue delivered his lecture on "Ultra Thin Magnetic Films: Why Choosing the Electrochemical Route." There, he gave an overview on his work on the electrodeposition of gold and ferromagnetic metals on silicon, as well as his more recent efforts in using electrodeposition to determine metal binding energy at surfaces and to probe the formation and dissolution of two-dimensional alloy phases. Philippe Allongue is Research Director at the Centre National de la Recherche Scientifique (CNRS) at the Ecole Polytechnique, Physique de la Matière Condensée, in Palaiseau (France).



Mark Verbrugge, Director of the Materials and Processes Laboratory of General Motors gave the plenary lecture, "Energy and Personal Transportation" on Sunday evening to start the E2S (see page 10 for a synopsis of this talk). Global energy issues, trends in personal transportation worldwide, and electrochemical energy storage technologies were central to the presentation. The presentation was well received and catalyzed extensive discussion about energy as well as the role of the ECS in promoting electrochemical energy research.



The STUDENT POSTER SESSION at the Monday Evening Mixer in Boston was its usual lively mixture of meeting up with friends and colleagues, and the very intense work of the Student Poster Session organizers and judges to select winners from the 97 posters submitted to the session.

The panel discussion, held on Monday, brought together five international panelists, each expert in policy and energy needs, generation, and storage. The lively discussion was led by Krishnan Rajeshwar, Editor of *Interface* and Distinguished University Professor at the University of Texas, Arlington. The panelists were Eric D. Isaacs, Director of Argonne National Laboratories; Tatsuya Shinkawa, Chief Representative to Washington, DC of New Energy and Industrial Technology Development Organization (NEDO), Japan; Detlef Stolten, Juelich Research Center and University of Technology, Aachen, Germany; John A. Turner, Research Fellow at National Renewable Energy Laboratory (NREL); and the plenary speaker, Mark Verbrugge. All panelists are accomplished scientists and engineers involved in policy making. Responses to questions from the audience were insightful. Diverse perspectives, all focused on societal energy needs, were surprisingly coherent in recognition of the rich opportunities of electrochemical energy solutions. Expectation, optimism, and urgency were apparent across the panel. Very clear statements on the need for education and communications about true linkages between scientific facts and solutions were made.

Almost 100 posters were presented in three separate sessions. The poster sessions were lively and presented opportunity for discussion between a wide range of participants and meeting attendees. Policymakers and program managers had an opportunity to interact with scientists and engineers best able to build

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MACCOR was the sponsor of the Student Poster Session Awards at the ECS meeting in Boston. Winners from the Student Poster Session awards gathered with ECS President ESTHER TAKEUCHI (6<sup>th</sup> from left) and Session Chair VENKAT SUBRAMANIAM (7<sup>th</sup> from left), their advisors, and with some of the judges from the selection committee. MARK HULSE (5<sup>th</sup> from left), Maccor V. P. of Sales and Marketing, represented the company.

The Chair thanked all the members of the award selection committee: **Frank Chen and Marca Doeff** (Battery Division); **Vicki Geling and Matt Strom** (Corrosion); **Oana Leonte and Ravi Toddi** (DS&T); **Paul Trulove** (Physical & Analytical Electrochemistry Division); **Emiliana Fabbri** (High Temperature Materials Division); **Vijay Ramani, John Staser, and Cynthia York** (IE&EE Division); **Zoraida Aguilar and Alexander Simonian** (Sensor Division); and **N. Prasanth Kumar and James Murphy** (Luminescence & Display Materials Division).

The poster session winners were: **Jesse Benck** (Stanford University), First Place, Electrochemical Science & Technology Award; **Francis Richey** (Drexel University), First Place, Solid State Science & Technology Award; **Damilola Daramola** (Ohio University) and **Lingchong Mai** (Ohio University), Second Place, Electrochemical Science & Technology Award; and **Benjamin Caire** (Colorado School of Mines), **Ashley Maes** (Colorado School of Mines), and **Melissa Vandiver** (Colorado School of Mines), Second Place, Solid State Science & Technology Award.



**GRETA UHLIG** (4<sup>th</sup> from left), widow of Herbert H. Uhlig, at the Corrosion Division Award Reception in Boston. From left to right are: **HONGBO CONG** (2011 Corrosion Division Morris Cohen Graduate Student Award winner), **PATRIK SCHMUKI** (2011 Corrosion Division H. H. Uhlig Award winner), **BARRY MACDOUGALL** (ECS Fellow and 1995 ECS Carl Wagner Award winner), (Mrs. Uhlig), **KOJI HASHIMOTO** (2011 Palladium Award winner), **ROBERT FRANKENTHAL** (ECS Fellow, 2008 Edward G. Acheson Award winner, and 1989 H. H. Uhlig Award winner), **GERALD (JERRY) FRANKEL** (ECS Fellow and 2010 H. H. Uhlig Award winner), and **JOHN SCULLY** (ECS Fellow and 2009 H. H. Uhlig Award winner).



The ECS meetings are the place for electrochemists from around the world to learn about new science and technology, as well as to meet the leaders of other technical societies. In Boston, **TETSUYA OSAKA**, ECS Second Vice-President (far left) and **ROQUE CALVO**, ECS Executive Director (third from left) had the opportunity to catch up with **YOHTARO YAMAZAKI** (second from left), 2012-13 President-elect of the Electrochemical Society of Japan, and with **HASUCK KIM** (far right), 2012-13 President-elect of the International Society of Electrochemistry.

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transformative electrochemical solutions to societal energy. A *Directory of Electrochemical Energy Solutions* that lists researchers' presentations at the poster session was also generated. It can be accessed electronically at no cost at <http://tinyurl.com/7fbzqnc>. Bound paper copies are also available from ECS.

The E2S was organized by the ECS Treasurer, Christina Bock, National Research Council of Canada, and ECS Secretary Johna Leddy, University of Iowa. The meeting was supported by the Army Research Office and the extraordinary efforts of the staff and Executive Committee of ECS. ■

*Meeting Highlights were prepared by Krishnan Rajeshwar, Mary Yess, Johna Leddy, and Christina Bock.*

*All photos are by Frank Monkiewicz Photography, Belmont, MA.*