



San Francisco Travel Association photo by P. Fuszard.



224th
ECS MEETING
San Francisco, CA
October 27–November 1, 2013



San Francisco Travel Association photo.

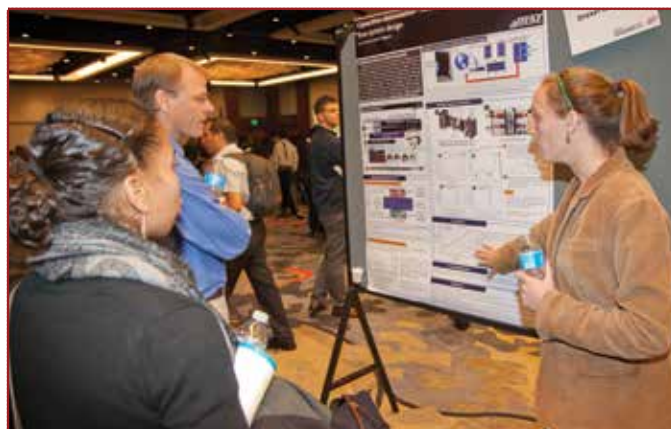
Highlights from the Meeting in San Francisco

Global energy needs continue to grow with economic, political, and environmental issues largely dictated by energy challenges. The third international ECS Electrochemical Energy Summit (E2S) kicked off the 224th ECS meeting in San Francisco, and set the tone for a week of presentations, posters, and

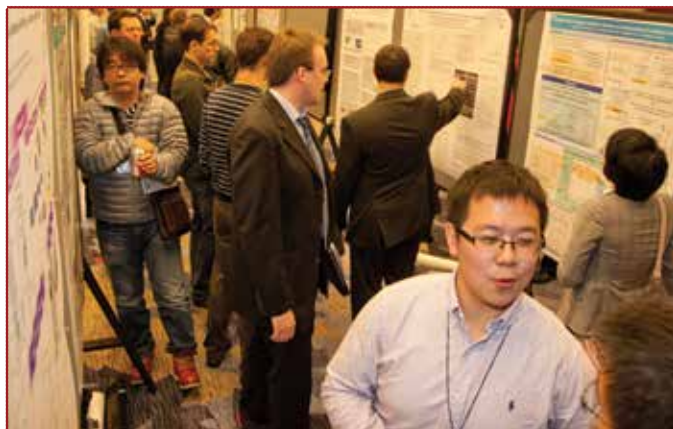
panel discussions from and among leading policy makers and energy experts about societal needs and technological energy solutions. Over 3100 attendees took in not only energy-related presentations, but other topics in electrochemistry and solid state science and technology, from a selection of over 2800 papers in 50 symposia and 40 exhibits.



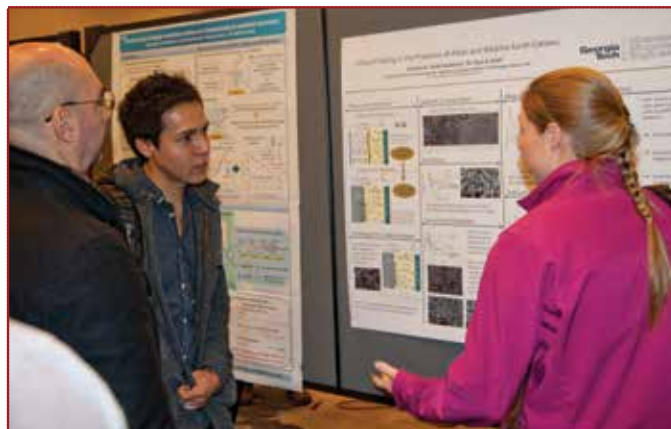
*The Electrochemical Energy Summit (E2S) panelists gathered before their talks. From left to right are: **HEATHER COOLEY**, Co-Director of the Pacific Institute's Water Program; Congressman **JERRY MCNERNEY**, 9th District of California; **MEREDITH YOUNGHEIN**, a Policy and Programs Analyst with the State Water Resources Control Board and on the Energy Division of the California Public Utilities Commission; and E2S organizer **ROBERT GLASS**, Senior Scientist in the Physical and Life Sciences Directorate at Lawrence Livermore National Laboratory.*



*Among the highlights of the Energy Summit was the **Energy Research Group Showcase**. Shown here is **Drexel University** presenting its work. Other participants included **Duke University**, **FMC Lithium**, **Lawrence Berkeley National Laboratory**, **Sandia National Laboratories**, **Stanford Woods Institute for the Environment**, **University of British Columbia**, **University of Kansas**, **University of Maryland**, **University of Toronto**, and the **University of the West of England**.*



*Another feature of E2S was an **energy-themed poster session**. Posters were selected from all poster submissions that were relevant to the Summit's energy theme. Shown here (right photo) is a participant from the **Georgia Institute of Technology**.*



Sunday kicked off the meeting with a full day of E2S events and activities. **Robert Glass**, Senior Scientist in the Physical and Life Sciences Directorate at Lawrence Livermore National Laboratory (LLNL), introduced the Sunday invited speakers and the Q&A sessions. The opening day's program included a series of speakers; an Energy Research Group Showcase; an energy research poster session; and an Educational Outreach Program/Fuel Cell Car Competition organized by the IE&EE Division of ECS.

Congressman Jerry McNerney, 9th District of California, was Sunday's keynote speaker. He is the only renewable energy expert in Congress and sits on the U.S. House Committee on Energy & Commerce, the oldest standing legislative committee in the U.S. House of Representatives. The Congressman, who holds a PhD in mathematics, served several years as an engineering contractor to Sandia National Laboratories in New Mexico. In 1990 Congressman McNerney moved to California, accepting a senior engineering position with U.S. Windpower, Kenetech. Dr. McNerney later began working as an energy consultant for PG&E, FloWind, the Electric Power Research Institute, and other utility companies.

The Congressman was followed by a presentation on "Energy-Water Nexus: Opportunities and Challenges," given by **Heather Cooley**. Ms. Cooley is Co-Director of the Pacific Institute's Water Program. She conducts and oversees research on an array of water issues, including the connections between water and energy, sustainable water use and management, and the impact of climate change on water resources.

Next up was **Meredith Younghein**, who focused her presentation on the topic of "Program and Policy Innovations at the Water-Energy Nexus." Ms. Younghein is on a dual assignment as a Policy and Programs Analyst with the State Water Resources Control Board and the Energy Division of the California Public Utilities Commission.

Throughout Sunday and through midday Monday, attendees had an up-close look at a Honda FCX Clarity car and the Mercedes Benz B Class FCell car on display, courtesy of the **California Fuel Cell Partnership**. The California Fuel Cell Partnership is a collaboration of organizations, including auto manufacturers, energy providers, government agencies, and fuel cell technology companies, that work together to promote the commercialization of hydrogen fuel cell vehicles.



*The ECS Meeting in San Francisco was fortunate to have the participation of Congressman **JERRY MCNERNEY**, 9th District of California (center), who joined ECS President **TETSUYA OSAKA** (left) and ECS Executive Director **ROQUE CALVO** (right) for a conversation following McNerney's talk.*



*Attendees had a great opportunity on Sunday and Monday to see two different hybrid cars provided by the **California Fuel Cell Partnership (CaFCP)**. **JUAN CONTRERAS**, of the CaFCP, gave meeting attendees a tour of one of the hybrid vehicles on display.*

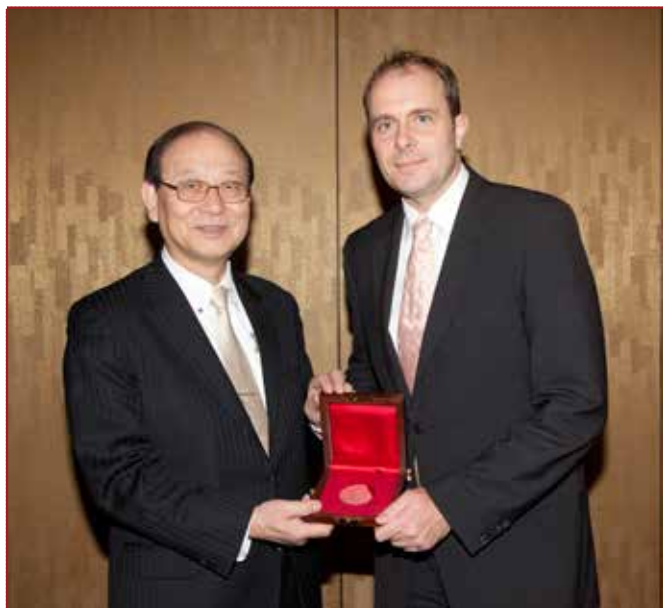


The Sunday program concluded with a reception and the twelfth **IE&EE Division's Educational Outreach Program**. This was the first time that the IE&EE Division brought the program to an ECS meeting, and it was great to see all those future scientists and engineers working away on their mini fuel cars, getting ready for the race. Over 90 students from **Galileo Academy of Science and Technology** and **Lowell High School** worked under the guidance of **Gerri Botte**, her students from the Ohio University Student Chapter of ECS, and members of the IE&EE Division. The program aims to foster the younger generation's interest in the fields of electrochemistry and electrochemical engineering and is designed to create awareness of electrochemical energy conversion devices.

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*Students from **Galileo Academy of Science and Technology** and **Lowell High School** worked under the guidance of **GERRI BOTTE** (bottom left photo), her students from the Ohio University Student Chapter of ECS, and members of the IE&EE Division.*



*The Society's Carl Wagner Memorial Award was established in 1980 to recognize a mid-career achievement and excellence in research areas of interest of the Society, and significant contributions in the teaching or guidance of students or colleagues in education, industry, or government. **MARC T. M. KOPER** (right) was presented with the 2013 award by ECS President **TETSUYA OSAKA** (left).*



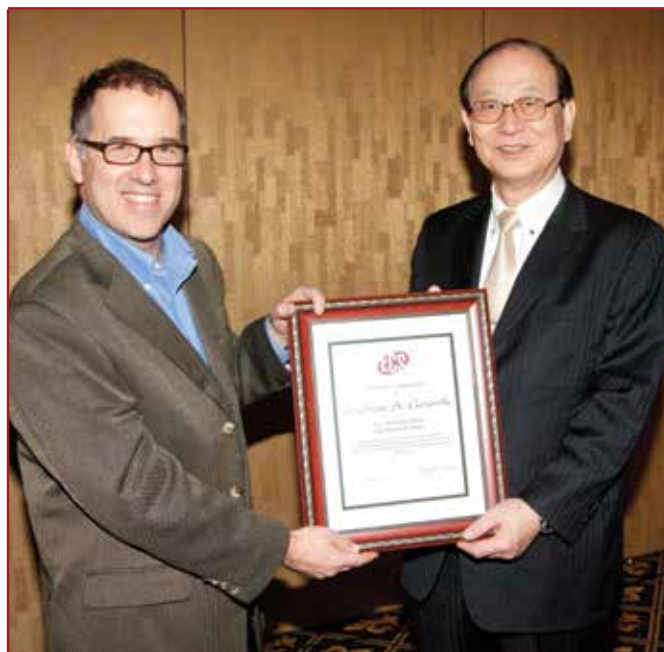
*ECS President **TETSUYA OSAKA** (right) thanked **FERNANDO GARZON** (left) for his outstanding contributions as ECS President during Dr. Garzon's 2012-2013 term.*



*ECS President **TETSUYA OSAKA** welcomed the 2013 Class of ECS Fellows. In the front row (left to right) are: **SHELLEY MINTEER**, **JOHNA LEDDY**, (*President Osaka*), **ELIZABETH OPILA**, **HÉCTOR ABRUÑA**, and **JAN ROBERT SELMAN**. In the back row (from left to right) are: **NANCY DUDNEY**, **GARY HUNTER**, **MARTIN WINTER**, **ENRICO TRAVERSA**, **JIRI JANATA**, **SANJEEV MUKERJEE**, and **KALPATHY SUNDARAM**.*



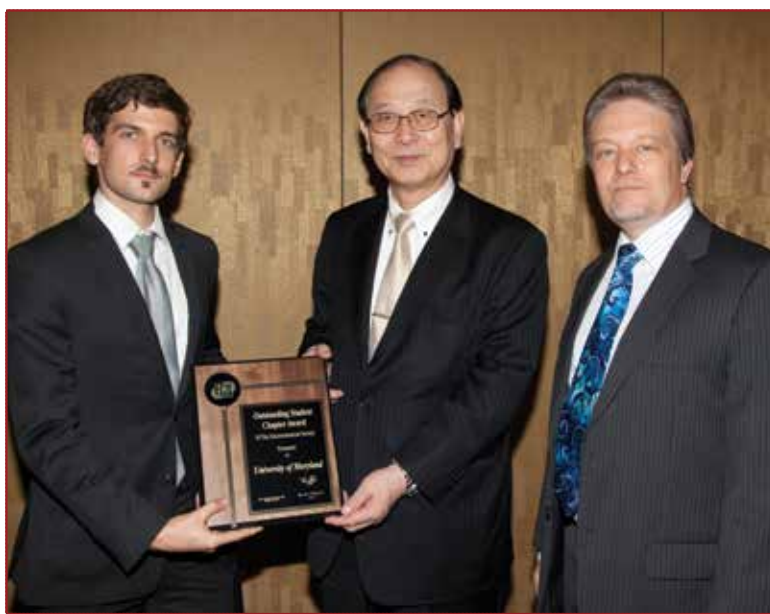
PETR VANÝSEK (left) was thanked by ECS President **TETSUYA OSAKA** (right) for his service as the Interim Editor of the Society's electrochemistry journals.



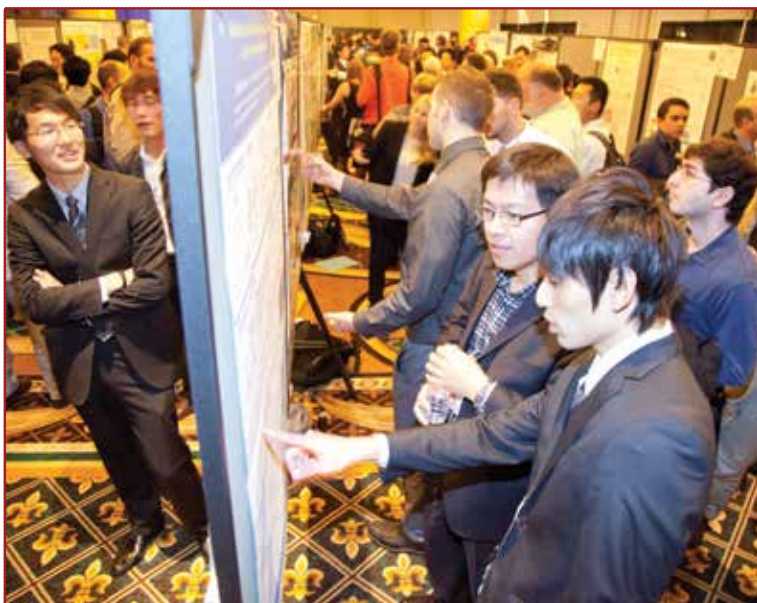
ECS President **TETSUYA OSAKA** (right) thanked **ANDREW GEWIRTH** (left) for his service as an Associate Editor and Technical Editor for the ECS electrochemistry journals.



Every year the Society selects two of the best papers published in the *Journal of The Electrochemical Society* (JES) for the Norman Hackerman Young Author Awards. Receiving his award for the best paper in solid state science and technology is **BALAVINAYAGAM RAMALINGAM** (left). He received his award from ECS President **TETSUYA OSAKA** (right). The winning paper was entitled, "Multi-Layer Pt Nanoparticle Embedded High Density Non-Volatile Memory Devices" [JES, **159**, 4, H393 (2012)]. Unable to attend the ceremony were **KELLEY "SYKES" MASON** and **KIERSTEN HORNING**, who received the award for the best paper in electrochemical science and technology. The winning paper was entitled, "Investigation of a Silicotungstic Acid Functionalized Carbon on Pt Activity and Durability for the Oxygen Reduction Reaction" (JES, **159**, 12, F871).



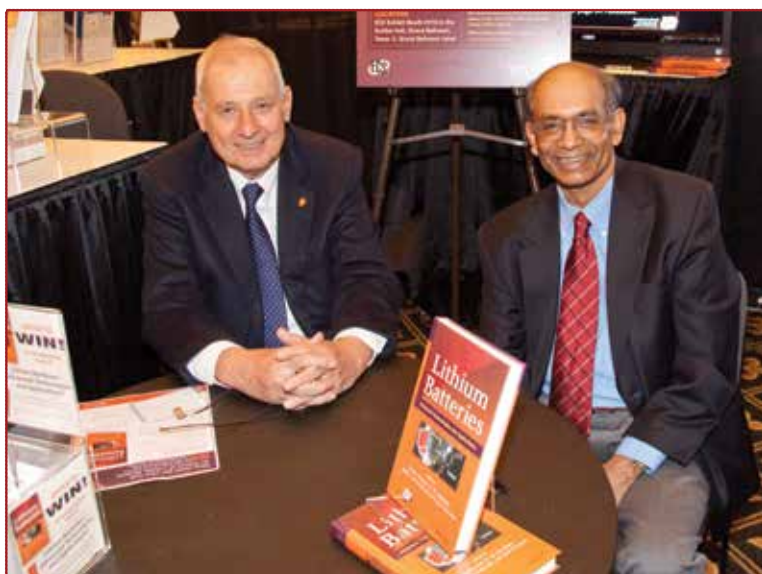
ECS presented the first Outstanding Student Chapter Award to the University of Maryland Student Chapter. ECS President **TETSUYA OSAKA** (center) presented the award to Chapter President **COLIN GORE** (left). Looking on is the Chapter's faculty adviser **ERIC WACHSMAN** (right).



Tuesday evening in the **Exhibit Hall** was filled with activity: attendees visiting the many exhibitors; the organizers and judges listening to presentations from participants in the **General Student Poster Session**; attendees excited to hear the winners of the **Lithium Batteries monograph giveaway**, sponsored by John Wiley & Sons; and people perusing the Society's journals at the ECS Exhibit booth.



BRUNO SCROSATI (left photo, at left), **KM ABRAHAM** (left photo, at right), and **WALTER VAN SCHALKWIJK** (above photo) were ready to sign copies before the special book signing of the newly-published **Lithium Batteries** monograph. Unable to attend the meeting with the fourth editor, **JUSEF HASSOUN**. The monograph is the latest in the series sponsored by ECS and published with John A. Wiley & Sons.



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On Monday, the E2 Summit continued with a special symposium on the **Energy–Water Nexus**, which featured invited speakers who examined the role of electrochemistry in addressing the intersection of these two critical resource issues, from policy considerations to scientific breakthroughs. The symposium was organized by **Eric D. Wachsman**, Director of the University of Maryland Energy Research Center, and the William L. Creutz Centennial Chair in Energy Research with appointments in both the Department of Materials Science and Engineering, and the Department of Chemical Engineering at the University of Maryland.

In addition to organizing the symposium, Dr. Wachsman also served as a moderator for the lively panel discussion that followed the presentations. Serving as the other moderator was **Carl Hensman** of the Water, Sanitation, and Hygiene team within the Global Development Program of the Bill & Melinda Gates Foundation. Prior to joining the foundation, Dr. Hensman was an Energy Program Manager for King County, Washington (Seattle) focusing on resource recovery in the Wastewater Treatment Division.



ERIC WACHSMAN, Director of the University of Maryland Energy Research Center, organized the **Energy–Water Nexus Symposium**, which featured invited speakers who examined the role of electrochemistry in addressing the intersection of these two critical resource issues.

The speakers on the Energy–Water Nexus panel included **Mike Hightower**, a Distinguished Member of the technical staff in the Energy Surety Engineering and Analysis Department at Sandia National Laboratories; **Antonio Busaliacchi**, Chair, National Academy of Sciences/National Research Council (NAS/NRC) Board on Atmospheric Sciences and Climate; **Amul Tevar**, ARPA-E Fellow who is working in energy–water, energy storage control systems (AMPED); **Michael Hoffman**, a member of the Engineering & Applied Science faculty at Caltech; and **Bruce Hamilton**, a program director at the National Science Foundation where he is a member of the cross-NSF Implementation Group for the Science, Engineering, and Education for Sustainability (SEES) investment area.

America's Energy Future: Science, Engineering, and Policy Challenges

All of the E2S activity was capped by The ECS Lecture given on Monday by **Mark Wrighton** of the Washington University (St. Louis, MO) to a packed audience.

Mark Wrighton is the 14th Chancellor of that university and joined that institution in 1995 after two decades of path-breaking research in photoelectrochemistry, chemically-modified electrodes, and mechanistic inorganic photochemistry at the Massachusetts Institute of Technology (MIT). Wrighton also served on the administration at MIT in varying roles as a department chair, dean, and provost. After completing his undergraduate education from Florida State University, he earned a PhD in chemistry from the California Institute of Technology under the joint tutelage of George Hammond and Harry Gray. Wrighton is one of the youngest professors tenured at MIT and he has been active in public and professional affairs throughout his career.

The plenary talk's theme grew out of Wrighton's involvement as the Vice-Chair of National Research Council (NRC)'s Committee on America's Energy Future (AEF). NRC convened this committee and charged it to study this country's future energy options; the report from the committee became public in the spring of 2009. (*Ed. Note: A Summary Edition is available on the Web from the National Academies Press.*)

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The Energy–Water Nexus Symposium hosted a panel discussion. From left to right are: **BRUCE HAMILTON**, a program director at the National Science Foundation; **CLEMENT CID**, California Institute of Technology; **ANTONIO J. BUSALIACCHI**, Chair, National Academy of Sciences/National Research Council (NAS/NRC) Board on Atmospheric Sciences and Climate; **AMUL TEVAR**, ARPA-E Fellow working in energy–water, energy storage control systems (AMPED); **MIKE HIGHTOWER**, a Distinguished Member of the technical staff in the Energy Surety Engineering and Analysis Department at Sandia National Laboratories; organizer and panel moderator **ERIC WACHSMAN**, Director of the University of Maryland Energy Research Center; and **CARL HENSMAN**, Water, Sanitation, and Hygiene team within the Global Development Program of the Bill & Melinda Gates Foundation.



MARK WRIGHTON (center) delivered *The ECS Lecture* at the San Francisco meeting. ECS President **TETSUYA OSAKA** (right) thanked Dr. Wrighton for his talk. ECS Senior Vice-President **PAUL KOHL** (left) introduced Dr. Wrighton whose lecture was on the topic of “America’s Energy Future.”

The speaker was introduced to the audience by the ECS Senior Vice-President, Paul Kohl. Wrighton began his lecture by noting the leadership role that the Society has played in discussing the important topic of energy. As examples, he noted the energy summit that was held concurrent with the meeting in San Francisco, and the demonstration of hybrid vehicle technology and battery technologies. He then showed names of the 25 members of the NEC Committee and noted that 80% of them were National Academy members.

Dr. Wrighton began his interesting lecture by first noting the motivating factors underlying the NRC AEF Committee’s charter. These could be grouped under concerns with the environment, national security, and economic competitiveness. A major conclusion emerging from the AEF report was that we must transform the manner in which energy is generated and used. While technology options were considered by the Committee, options not covered by the study scope included conservation, exploration and extraction, and the global situation.

The speaker then turned to a summary of the eight major findings from this study. A critical issue was also identified as carbon emissions from the continued and increasing use of fossil fuels. It was noted that China was the major CO₂ emitter among the non-OECD nations. The Mauna Loa observatory in Hawaii, which has monitored CO₂ emissions, now reports a level of ~400 ppm (v/v) for this greenhouse gas.

Turning to the concluding portion of this fast-moving talk, Wrighton suggested that nuclear and renewable energy options could be expanded from present levels. He underlined the criticality of searching for energy sources with minimal CO₂ emissions from their use. On a cautionary note, Japan was identified as a country with ~30% of its electricity generated from nuclear sources. However, plans for the construction of 14 new plants were abandoned in the light of the Fukushima disaster. The uncertainty associated with uranium supply also constitutes another drawback with this energy option. On the other hand, to what extent is the abundance and low cost of natural gas going to delay expanding the role of renewables in the future energy mix? Photovoltaics R&D has been intense in this country and elsewhere but concerns with economics/grid parity and the concomitant pressure on land use for farming continue to challenge an increasing role for this clean energy option. Plugging of renewable energy sources into the electric grid also will require a viable storage strategy to combat their intermittency.

Wrighton wrapped up his talk by identifying some policy challenges including the unfortunate dependency of energy R&D emphasis on

election cycles, and the need for incentives and taxes to curtail carbon emissions and to promote cleaner options. He wryly noted that the 50 states in the U.S. had virtually 50 energy policies. Most daunting, infusion of considerable capital and funding will be needed to secure efficiency gains and enable expensive options like nuclear.

All in all, this talk nicely dovetailed with the ongoing discussions on energy and the environment at the meeting.

The ECS Olin Palladium Award Lecture

The Olin Palladium Award lecture entitled, “Mathematical Modeling of Lithium Ion Cells and Batteries,” was given by **Ralph White** on Monday afternoon. Dr. White is a Professor of Chemical Engineering and a Distinguished Scientist at the University of South Carolina. He received his PhD from the University of California at Berkeley in 1977 under the direction of John Newman. After a distinguished career at Texas A&M University spanning 16 years, he moved to the University of South Carolina where he served both as chair of the Department of Chemical Engineering and as dean of the college. Professor White’s career accomplishments have garnered numerous awards and recognitions including elections as a Fellow of ECS, American Institute of Chemical Engineers, and American



RALPH WHITE (right) was the recipient of the 2013 Olin Palladium Award, and received his Medal from ECS President **TETSUYA OSAKA** (center). **JOHN NEWMAN** (left) introduced Dr. White earlier on Monday, when Prof. White gave his award talk. The Society’s Palladium Award was established in 1950 for distinguished contributions to the field of electrochemical or corrosion science. It is one of the Society’s most prestigious awards.

Association for the Advancement of Science. He has also served as a Treasurer of the Society.

After being introduced to the audience by John Newman, Dr. White began his award lecture by acknowledging the contributions of his 50 PhD and 39 Master’s students, and thanking family members, many of whom were present at the talk.

Professor White’s award lecture provided a summary of the capabilities of mathematical modeling of both single Li ion cells and battery packs constituting these individual cells. He noted, as a practical example of the application of Li battery technology, that the Chevrolet Volt vehicle had 288 such cells assembled into a 16.5 kWh battery pack module.

Mathematical models are useful as a design enabler in that they guide cell design by predicting the effect of changing parameters on cell performance. Physics-based models, such as the ones Prof. White described in his talk, generate predictive profiles of voltage-time charge/discharge profiles as a function of operating condition. The speaker discussed the underpinning features of models (P2D and P3D)

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Symposium in Honor of Adam Heller Celebrating his 80th Birthday



ADAM HELLER spoke at a symposium in his honor at the ECS fall 2013 meeting.



ADAM and ILANA HELLER at a dinner following the symposium in Prof. Heller's honor.

A symposium held in San Francisco honored **Adam Heller** on the occasion of his 80th birthday. Twenty-nine invited lectures spanned topics pioneered by Dr. Heller, including photovoltaics, novel batteries, and electrochemical solutions to biomedical challenges. Dr. Heller opened the symposium with a perspective of his career thus far, titled “At 80: The Joy of Uncovering Truths and Building People-Serving Products.”

Other highlights included the 2013 ECS Gerischer award winner, Arthur Nozik (NREL), who described his contributions to photoelectrochemical and quantum dot-based solar energy conversion; and Kazuhito Hashimoto, who discussed bioelectrochemical control of the circadian clock.

In closing the session, Heller observed: “It’s unbelievably important—and that’s perhaps the most important thing—that we, in this room, are speaking twelve different mother tongues... Suddenly it comes to your mind that science has not only created a community of the people that are leading the world, the cutting edge of what makes people move forward. But not in the sense of the technology only, but that we are the exemplary group of people able to work with each other, love each other, and be very good friends with each other. So, I cannot thank you more, and more deeply, for your friendship.”

A dinner event was also held on Monday night in a restaurant in the city and was attended by Prof. Heller’s family, students and postdoctoral fellows both past and present, and a multitude of friends both from inside and outside of the Society.

These two events held in concurrence with the ECS fall meeting exemplified the affection and admiration with which Prof. Heller is held by the scientific community.



ADAM HELLER (4th from left) gathered with his colleagues at the symposium held in his honor at the ECS meeting in San Francisco. In the front row on the far right is Interface Editor **KRISHNAN RAJESHWAR**.

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at the single-particle level including the Butler-Volmer formalism. How these models could extend to situations inside an actual module (Quallium 72 Ah) was outlined. Thus the physics-based model can be extended to multiple dimensions to predict the temperature distribution in a Li ion cell for a given set of operating conditions.

Application of these models to design a thermal management system was discussed to ensure that the heat generated in the cell is rapidly removed before causing overheating and thermal runaway of the cell. Such a discussion is particularly poignant in the face of recent problems with fires caused by overheating in Li ion cells in airplanes and automobiles.

Thermal management systems are also enabled by models on battery packs as discussed in the next part of the award lecture. How circuits could be balanced to extend battery life of the packs and how control algorithms could be developed to ensure successful operation of the battery over the life of the pack formed the topic for the next phase of the award lecture.

Overall, Dr. White's talk provided a clear demonstration of the power of predictive mathematical models for Li ion cells and battery packs. ■

Meeting Highlights were prepared by Krishnan Rajeshwar and Mary Yess, Interface's Editor and Managing Editor respectively.

All photos are by Dave Bush Fine Photography, San Francisco, CA.

PEFC 13 Award Winners

During the **PEFC 13 Symposium** in San Francisco, the symposium conducted a competition for the best student posters. Out of 30 competitors presenting generally high quality work, the judges chose four posters as winners.

Two poster presenters tied for the first place award of \$1,000 (each). They were **Yuichi Seno** from Yamanashi University (Kofu, Japan), with a poster entitled, "Electrochemical Properties of Pt Catalysts Supported on Nb-Doped SnO_2 with Network Structure;" and **Iryna V. Zenyuk** from Carnegie Mellon University for her poster

entitled, "Coupling of Deterministic Contact Mechanics Model and Two-Phase Model to Study the Effect of Catalyst Layer/Microporous Layer Interface on Polymer Electrolyte Fuel Cell Performance."

Yuta Ikehata from Doshisha University (Kyoto, Japan), with his poster entitled, "Scale-Up Synthesis of Au Core/Pt Shell Structured Catalysts and Their Electrochemical Properties," shared the second prize of \$500 each together with **Takuya Tsukatsune** from Kyushu University, Japan for his poster entitled, "Electrochemical Properties and Durability of Electrocatalysts Supported on SnO_2 ."



Winners of the PEFC 13 Symposium's student poster session competition posed with three of the organizers. Pictured from left to right are: YUICHI SENOO (Yamanashi University), JAMES FENTON (organizer), YUTA IKEHATA (Doshisha University), HUBERT A. GASTEIGER (organizer), TAKUYA TSUKATSUNE (Kyushu University), THOMAS J. SCHMIDT (organizer), and IRYNA V. ZENYUK (Carnegie Mellon University).