223rd ECS Meeting Highlights

May 12-16, 2013 • Toronto, ON, Canada

The 223rd ECS Meeting was the ninth time ECS held one of its biannual meeting in Toronto, and the "tradition" of meeting in this great city started in 1911. Meeting attendees had the opportunity to not only choose from over 1500 presentations in 44 symposia; but to sample some of the city's renowned offerings: a wide variety of restaurants, one of the largest zoos in the world, and the great public art on display in the streets.

At the ECS meetings, there are many opportunities to meet fellow scientists and engineers; but there are also ways to engage with the Society's institutional members, including at the popular technical exhibit and mixer events. Organizations are also involved with ECS through the institutional membership program that began almost 70 years ago. At the plenary session on Monday, ECS was able to thank two of these members with Leadership Circle Awards: both **Permascand AB** and **Evonik Litarion GmbH** reached the Silver Level Leadership Circle Award for 10 years of Institutional Membership with ECS.

From the meeting program to the Annual Society Business Meeting to the Board of Directors meeting, participants saw evidence of the meeting's many "green" initiatives. The meeting app continues

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Michael Mayberry *delivered The ECS Lecture, entitled "The Frontier of Electronics Research," at the plenary session of the 223rd ECS Meeting. Dr. Mayberry is Corporate VP of the Technology and Manufacturing Group and Director of Components Research at Intel.*

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to improve with every iteration, enabling attendees to look at a meeting abstract right on their mobile devices, and also eliminating the need to use (and throw away!) so much paper. Growing support from sponsoring organizations makes the meeting app possible, as well as the Internet Café, and job searching through Redcat, the Society's research and community website.

In addition to its very active Divisions, ECS is proud to have dynamic Sections throughout the world. Like the Divisions, the Sections also have a strong awards program, and typically these awards are presented during the Section's own meetings. In Toronto, the Europe Section changed their normal schedule and presented the Alessandro Volta Medal to **Jean-Noël Chazalviel** from CNRS in Paris.

The Society's mission to advance electrochemistry and solid state science is supported by a strong publications program. The Society's publications have been experiencing continuous growth in submissions, which demands an enormous amount of work from our editors. In Toronto, two members of the editorial team were thanked for serving the Society's publications so well, including **Andrew A. Gewirth** for his work as a Technical Editor for the Society's journals, and **John Weidner** for serving as Editor of *ECS Transactions*.

The Frontier of Electronics Research

The ECS Lecture, during the Monday plenary session, was given by **Michael Mayberry** of Intel Corporation to a packed audience. He is Corporate VP of the Technology and Manufacturing Group and Director of Components Research at Intel. He is responsible for coordinating research to enable future process options for Intel's technology development units. The scope of his responsibilities includes both internal and external (university) research, and other strategic R&D partnerships. As part of Intel's California Technology Development team he was involved in EPROM, flash, and logic wafer fabrication innovation. Mayberry received his PhD in physical chemistry from the University of California, Berkeley in 1983.

After Dr. Mayberry was introduced by ECS 2nd Vice-President Paul Kohl, the speaker began his fast-moving and informative lecture. The entire talk was sprinkled with interesting quotes from Arthur C. Clark. He began by noting that the technology was poised at the 22 nm node. Thus, about 7500 transistors are packed into a region of space the dimension of a dot on the letter "i"! The challenge now is to follow the progression dictated by Moore's law in terms of the number of devices that can be packed together in any given surface area. This inevitably means building complex 3-dimensional structures. The speaker turned to a discussion of quantum well (QW) field effect transistors built from Group III-V semiconductors and new-generation devices based on silicon nanowires.

Beyond the 22 nm node he noted that carrier scattering from grains and sidewalls becomes dominant. Dr. Mayberry pointed out that interconnects become the limiter in device performance. Thus current research on aspects related to new interconnect materials (*e.g.*, carbon nanotubes, CuAu alloys) were discussed along with the cost limitations associated with the use of elements such as gold.

To continue to deliver the expected gains beyond the 22 nm node, Dr. Mayberry noted that several things had to happen congruently. First, the leakage current has to be managed, which means a change in structure to multi-gate configurations; and managing tunneling currents and scattering would be another challenge.

The talk then turned futuristic, looking at possibilities of shrinking feature sizes down to 10 nm and then even to 1.5 nm. At this juncture we reach the space of chemistry where you build individual molecules. The 10 nm-5 nm roadmap would involve further advances in lithography, materials, interconnects, and more. At the end of scaling, which Dr. Mayberry predicted would occur in about 10 years, one could even envision a post-Si nanoelectronics future. The speaker alluded to a device

Fan Ren *(right) received one of the Society's highest awards, the Gordon E. Moore Medal for Outstanding Achievement in Solid State Science and Technology, from ECS President* **Fernando Garzon** *(left).*

ECS President **Fernando Garzon** *(left) thanked* **John Weidner** *(right) for his years of service as Editor of* ECS Transactions.

The Chair of the Fullerenes, Nanotubes, and Carbon Nanostructures Division, **R. Bruce Weisman** *(right), presented the Division's Richard E. Smalley Research Award to* **Nazario Martín** *(left) during the Toronto meeting. The Award is intended to recognize in a broad sense, those persons who have made outstanding contributions to the understanding and applications of fullerenes.*

future beyond CMOS and into the realm of spintronics, and the search for the next switch. He then addressed non-Boolean logic possibilities and underlined that fabricating a spintronic circuit would require precise metrology and new strategies for measuring logic states. He concluded by summarizing the key developments needed in areas such as metrology and characterization to further advance manufacturing processes.

The Gordon E. Moore Award Lecture

The award lecture, entitled, "Wide Bandgap Semiconductors for Sensing Applications," was given by **Fan Ren** on Monday afternoon. Professor Ren is a leading figure in GaN-based sensors for gas and chemical detection and for medical diagnostics. After getting his PhD from Brooklyn Polytechnic Institute in 1991 and completing a post-doctoral training at AT&T Bell Labs, where he played a key role in heterojunction bipolar transistors and MOSFETs, Dr. Ren joined the University of Florida in 1998. He is currently a Distinguished Professor in the Department of Chemical Engineering and an ExxonMobil Gator Chemical Engineering Alumni Chair professor.

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A gathering of editors—ECS has been privileged to have had the leadership and hard work of so many talented people as journal editors. At the Toronto meeting, the cameras captured five of them (from left to right): **Dan Scherson**, *former Editor of the Society's Electrochemical Science and Technology (EST) journals;* **Petr Vanýsek**, *former Interim Editor of the EST journals;* **Barry Miller**, *former Editor of the* Journal of The Electrochemical Society*;* **Dennis Hess**, *current Editor of the Solid State Science and Technology journals; and* **Paul Kohl**, *former Editor of the* Journal of The Electrochemical Society *and* Electrochemical and Solid State Letters.

Some of the Society's former Presidents attended the Annual Society Business Meeting (front row, left to right): **William Brown** *(2010-2011),* **Fernando Garzon** *(2012-2013), and* **D. Noel Buckley** *(2008-2009). In the back row (left to right):* **Barry Miller** *(1997-1998),* **Dennis Hess** *(1996-1997),* **Robin Susko** *(2004-2005), and* **Richard Alkire** *(1985-1986).*

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After being introduced to the audience by the ECS President Fernando Garzon, Dr. Ren began his award lecture acknowledging his collaborator and nominator, Steve Pearton. The lecture focused on the development of AlGaN/GaN junction-based transistors (HEMTs) for gas and bio-sensing applications. In general, the HEMT gate can be coated with selective agents for the gaseous and ionic solution analytes. The sensing mechanism is based on altered barrier height in the transistor device because of analyte interactions. The resultant signal may be amplified to provide for very high sensitivity. The use of semiconductor-based solid-state devices naturally lends to "field-able" and remotely-accessible sensors.

He gave examples of recent work from his group in this area for sensitive and selective detection of several families of analytes based on biomolecules (*e.g.*, kidney injury biomarkers and endocrine disruptor biomarkers in fish); mercury; and gases such as hydrogen, CO and CO_2, arsenic, methane, pesticides etc. In particular a field example based on leak detection of hydrogen in an electric car was interesting to this writer (KR).

Dr. Ren pointed out that the biosensor market is poised to reach $4.4 billion by 2014 in the U.S. He also underlined the strong demand for biosensors in divergent market sectors in biodefense, environmental monitoring, food, and pharma. Sensors that are adaptable to point-of-care or on-field use and have high precision, compact size, fast response, and high selectivity would be particularly relevant to such application needs. Dr. Ren's award talk provided a clear demonstration of how AlGaN/GaN sensors fulfilled these requirements.

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

All photos are by MARYPiCS Photography, Canada.

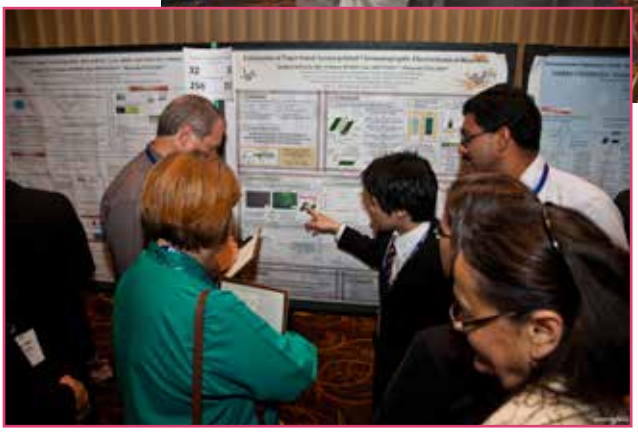
ECS President **Fernando Garzon** *(top left) convened the Annual Society Business Meeting with reports by ECS Secretary* **Lili Deligianni** *(top right), and ECS Treasurer* **Christina Bock** *(bottom left).* **Krishnan Rajeshwar** *(bottom right) also attended as the 3rd Vice-President-elect.*

The Society's newest **JOURNALS** *were on display in Toronto.*

Visitors to the **REDCAT** *booth were treated to a limited-edition Redcat hat—redcatresearch.org—have you joined yet?*

ECS CENTRAL *provides a wealth of information for authors, readers, and meeting attendees.*

Scenes from the General Society Student Poster Session . . .



The award winners received their awards and congratulations from **Kalpathy Sundaram** *(organizer) at far left, ECS President* **Fernando Garzon** *(second from right), and* **Vimal Chaitanya** *(organizer).*

Recipients of the Student Poster Session (above) awards posed with their presentations. **Michal Osiak** *(far left), University College Cork, was awarded the first place prize in the category of electrochemical science and technology for his poster, "New Routes Toward the Formation of Tin Oxide Inverted Opals for Charge Storage Applications."* **Andrew J. Naylor** *(center), University of Southampton, was awarded the first place prize in the category of solid state science and technology, for his poster, "Electrodeposition of Copper/Indium-Doped N-Type Bismuth Telluride-Based Thermoelectric Nanomaterials."* **Danielle Smiley** *(right), McMaster University, was awarded a second place prize in electrochemical science and technology, for her poster, "Studies of Ion Dynamics in Cathode Materials for Lithium Ion Batteries Using Solid-State NMR."*