

meeting highlights

SAN FRANCISCO

The “city by the bay” welcomed attendees of the ECS-ISE Joint International Meeting with beautiful weather and a congenial atmosphere. Over 2,010 participants presented 1,575 papers in 26 technical and two poster sessions. This meeting—the 200th meeting for ECS and the 52nd meeting for ISE—was the second such gathering of the two international groups; the previous one was held in Paris in 1997. Attendees took advantage of several excellent keynote lectures, an interesting and varied technical exhibit, and numerous complimentary social functions. A new meeting feature was introduced: a CD-ROM of the Meeting Abstracts book.

Plenary Lecture

The plenary lecture, entitled, “Field-Induced Charges in Organic Crystals: New Perspectives for Science and Technology,” was given by **BERTRAM BATLOGG**, a Professor of Physics at ETH, Zurich. The talk focused on a new generation of organic semiconductors, their attributes relative to inorganic semiconductors such as Si and Group II-V compounds, and their applicability to molecular electronics and opto-electronic devices. These materials cover a wide spectrum and include buckyballs, oligothiophenes, and organic compounds with extended pi-electron conjugation such as pentacene and tetracene. Dr. Batlogg reminded the audience of a key structural feature of these materials, namely, an absence of surface states that results from the van der Waals bonding of their constituent molecules. Surface states, of course, are a bane for a given semiconductor in terms of its electronic properties and device applicability.

The speaker pointed out that organic semiconductors (or molecular crystals) are usually grown by vapor phase transport. Doping is accomplished by using iodine as a carrier. Dr. Batlogg discussed alternative doping strategies based on field-effect doping. Contrasting with conventional approaches, field-effect doping allows for two-dimensional tuning of the carrier density over a 10^9 - 10^{14} cm^{-2} range, simply by varying the applied voltage to a field-effect transistor (FET) configuration. Hole mobilities as high as 10^9 $\text{cm}^2/\text{V}\cdot\text{s}$ have been attained in organic semiconductors with carrier scattering losses lower than most inorganic counterparts except GaAs grown by molecular beam epitaxy. Using pentacene as a model system, he described ambipolar FET devices made from either n-type or p-type channels generated by the field-effect doping method. In terms of switch speed, frequencies up to ca. 700 kHz have been attained. A five-stage ring oscillator was shown as an example, with pentacene as the active component. This device had a delay of 0.15 microsec/stage and a channel width of 25 micrometers.

In terms of optoelectronic device applications, Dr. Batlogg pointed out that the grain boundaries in pentacene have a co-operative effect such that they have only a minimal impact on carrier mobility. Photovoltaic devices, again based on pentacene as the semiconductor and ZnO and Au as collector contacts, exhibit a light-to-electricity conversion efficiency in the 2.7-4.5 % range. Other device examples discussed included a light-emitting transistor based on tetracene for laser applications.

These materials also appear to show promise in the search for high T_c superconductors. Thus pentacene and tetracene have insulator-to-superconductor transitions of 2 K and 2.5 K respectively. Solution-processed polythiophenes constitute another category of promising organic materials in this regard. The fast-moving talk concluded with a discussion on C_{60} and gate-induced hole superconductivity in it. Professor Batlogg pointed out that field-effect doping, while not a new approach in and of itself, opens a new way to the simultaneous study of materials, many-body physics problems, and devices. He similarly underlined the fact that organic semiconductors may not replace Si-based electronics in the near future. Rather, they provide an intriguing and low-cost alternative for throw-away electronic devices. All in all, this talk had the right balance of depth and the broad-brush perspective befitting a plenary lecture. A packed audience of specialists and neophytes alike in the overlapping field of molecular electronics and materials science certainly enjoyed it.

ECS Olin Palladium Award Lecture

NORIO SATO, Emeritus Professor of Hokkaido University, gave his award address entitled, “Surface Oxides in Metallic Corrosion,” on Tuesday in a Corrosion Division symposium.



JOINT INTERNATIONAL MEETING OPENING DAY—Officially opening the meeting were the presidents of the two societies, **ERIKA KÁLMÁN**, ISE President (second from left) and **JAN TALBOT**, ECS President (third from left). Joining them were **ROQUE CALVO**, ECS Executive Director (far left); **BERTRAM BATLOGG**, Plenary Lecturer (second from right); and **OTMAR DOSSENBACH**, ISE Executive Director (far right).



2001 CLASS OF ECS FELLOWS—ECS President **JAN TALBOT** (seated, second from left) welcomed the new Fellows to the Society. They are (seated, left to right) **SHOHEI NAKAHARA**, (Talbot), **JAMES MCBREEN**, and **PATRICK MORAN**; standing, from left to right are **DAVID LOCKWOOD**, **SUPRAMANIAN SRINIVASAN**, **DIETER M. KOLB**, and **WILLIAM O'GRADY**.

sium. The theme of his lecture was that oxides either help or oppose corrosion, depending on their ionic, electronic, and electrochemical properties. The talk was divided into four topics: oxide precipitates, semiconductor oxides, redox oxides, and passive oxides. Professor Sato began with a discussion of precipitates using hydrous iron oxides in chloride media as an example system. He showed how anion selectivity aided corrosion, while cation selectivity facilitated proton flux out of the layer thus preventing corrosion. In the iron oxide system, both types of behavior are encountered depending on pH and ion adsorption in the hydrous surface layer. Dr. Sato then discussed bipolar layers and also showed that no surface passivation occurs with anion-selective layers.

Turning next to semiconducting oxides, he discussed the importance of the relative locations of the open-circuit potential, flat-band potential, and the corrosion potential in the oxide-coated metal system. Under some conditions, local galvanic cells are created resulting in hydrogen evolution reaction (HER) and dioxygen evolution on the metal and oxide surfaces respectively. As an example, he showed how copper and stainless steel corrosion were reduced when coated with $n\text{-TiO}_2$. The behavior was shown to be very different with p-type oxide layers. Here HER couples with anodic metal dissolution resulting in pitting corrosion.

The third system for discussion constituted redox oxides. Both electron and proton transfer occur in these cases as exemplified by the effect of iron rusts on atmospheric steel corrosion. Zinc oxide reduces this effect being both n-type and anion-selective. The final discussion centered on passive oxide films. The relative location of the semiconductor Fermi level and its bandgap edges dictate whether the open-circuit potential of the system is pinned in the passive oxide (stable) state or in the (active) trans-passive regime. Two types of examples were provided, one based on iron or nickel oxide films where non-oxidative film dissolution occurs in the trans-passive regime. On the other hand, film dissolution occurs in the oxidative mode in the chromium oxide system.

Finally chloride-induced breakdown of passive films was discussed with Prof. Sato's own interpretation of the prevailing mechanism. He acknowledged that the mechanistic details in this case comprised a subject of continuing debate. This award lecture was most impressive in terms of its clarity and even a non-specialist (such as this writer) could come away from it with at least a basic knowledge of the importance of electron and ion transfer phenomena in corrosion processes.

ISE Pergamon Medal Lecture

The Pergamon Medal lecture entitled, "Microscopic Studies of Molecular Adsorption on Solid Metal Electrode Surfaces," was given by Professor A. J. ARVIA of INIFTA, Argentina, as part of the Electrochemical Deposition and Dissolution Symposium on Monday morning. In his lecture, Professor Arvia addressed the topics of island electrodeposition, adsorbate mobility, additives, and leveling. At the outset, he pointed out the virtues of combining AFM and STM with electrochemical probes for the study of these problems. Examples discussed included Pd and Au deposits on C(0001) and Au(111) surfaces and Cu deposition in the presence of thiourea. He pointed out the common features in these systems, in terms of prevailing non-equilibrium conditions, were the importance of ion and molecular adsorbate dynamics, and surface relaxation.

Focusing first on Au electrodeposition, he pointed out that radial island growth occurs in this case under diffusion-controlled conditions. He presented results from Monte Carlo

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1. ECS OLIN PALLADIUM MEDALLIST—NORIO SATO (left) received the Olin Palladium Award from JAN TALBOT, ECS President. The award is presented for outstanding contributions to the fundamental understanding of all types of electrochemical and corrosion phenomena and processes.

2. ISE PERGAMON MEDALLIST—ALEJANDRO ARVIA (right) received the ISE Pergamon Medal from ERIKA KÁLMÁN, ISE President. The award is presented biannually for the most significant contribution to electrochemistry in the previous two years.

3. A RARE HONOR—ECS awarded Honorary Member status to JEFFERSON C. COLE (left) for significant contributions to ECS. Dr. Cole is shown here with ECS President JAN TALBOT.

4. ECS CARL WAGNER AWARD—The Carl Wagner Award was presented to PAUL A. KOHL (right), Editor of the ECS journals, for excellence in research, as well as significant contributions in teaching. Presenting the award is ECS President JAN TALBOT.

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TRULY INTERNATIONAL—**GERARD BLOM** (far right), 1998-99 ECS President, was able to appreciate the fruits of his labor in San Francisco: The planning for the 2001 Joint International Meeting began several years ago under his leadership. Shown here with Blom are (left to right) **ERNESTO R. GONZALEZ**, President, *Sociedad Iberoamericana de Electroquímica*; **JAN TALBOT**, 2001-2002 ECS President; and **CARLTON OSBURN**, 2000-2001 ECS President.

simulations on this system that illustrated the phenomenon of directional branching as a consequence of the anisotropy. He also showed that citric acid interferes with surface diffusion and surface reconstruction. Thus, surface dynamics depends on the applied potential, solution composition, adsorption processes (as exemplified by chloride and citric acid) and temperature. The island shape crucially depends on surface diffusion processes and can be isotropic or anisotropic, such that the aspect ratio of the deposit can be tuned in favorable instances. In the Pd case, Dr. Arvia pointed out that the deposit island shape depended on the point of zero charge of the substrate.

Turning to the effect of thiourea on Cu electrodeposition, Dr. Arvia noted that no physico-chemical theory had been available to rationalize, on a molecular mechanistic basis, the effect of the additive. STM data were presented showing the striking influence of thiourea on the Cu deposit morphology. The micrographs clearly revealed how thiourea prevents unstable Cu growth (leading to very rough deposits) and “smoothes” out the bumps leading to an even layer. A dynamic scaling model was finally presented in an attempt to understand the growth features and the role of additive adsorption in diminishing surface diffusion and grain size. This award lecture provided a good perspective on how modern measurement probes—such as scanning microscopies and powerful simulation techniques—have together contributed to an improved understanding of classical and empirical electrodeposition procedures.

Fuel Cells for the Rest of Us

The newly-minted ECS meeting tradition of the Sunday evening lecture, which was started at the spring meeting in Washington, DC, continued with a talk entitled “Fuel Cells for the Rest of Us” by **ULRICH STIMMING** of the Technical University of Munich. As readers will recall, this series of talks is being planned on Sundays to provide the membership (and non-technical registrants) an opportunity to learn more about emerging “hot” topics in electrochemistry and solid-state research. Of course, fuel cells have been around for many years although they are enjoying a resurgence, thanks to energy and environmental concerns. Indeed the fuel cell symposia were exceedingly well-attended as were the technical sessions on another device cousin, namely batteries.

Board Highlights

Regular ECS business was conducted as well in San Francisco, with committees reporting interesting activity to the Board of Directors at its meeting on Thursday morning. The Ways and Means Committee recommended, and the Board approved, the formation of the **ARIZONA SECTION** (see story on page 53).

The Board approved a recommendation of the Publication Committee, to continue the current policy of **online access to the ECS journals as a member benefit**. The committee reported that there was lively discussion in a number of publication areas, namely efforts to provide wider distribution of the journals content, and to revamp the **Proceedings Volume (PV) series**. The committee recommended, and the Board approved, a plan to offer **free electronic subscriptions to academic institutions in developing nations**. After careful consideration of the many issues surrounding the timely and “compliant” publication of ECS PVs, the Publication Committee has made a number of changes to the requirements for publishing a Proceedings Volume. The committee is continuing to look at alternative publication models for PV papers.

The Honors and Awards Committee recommended, and the Board approved, the establishment of a new award, the **EUROPEAN SECTION HEINZ GERISCHER AWARD** (see story on page 53). Several 2002 award recipients were announced by the committee, including **SORIN CRISTOLOVEANU**, Electronic Division Award; **WENGSHENG HE**, IEEE Division H. H. Dow Memorial Achievement Award; and **VENKAT R. SUBRAMANIAN**, IEEE Division Student Achievement Award.

In the meetings area, several committees reported considerable activity. After the **Society Centennial Meeting in May 2002** (see story on page 8), the next meeting on the Society’s calendar will be **IMLB 11**, to be held in Monterey, California in June 2002, with abstracts due February 2, 2002 (see inside back cover for details). Planning is underway for the **2003 ECS spring meeting in Paris**. Because of the early date of the meeting, and other advance planning requirements, the abstract submission deadline will have an early date of November 15, 2002. Finally, future *Interface* Meeting Highlights may see a report on a joint international meeting with ECS, **La Sociedad Mexicana de Electroquímica**, **La Sociedad Iberoamericana de Electroquímica**, and **ISE**. Discussions have begun to explore this possibility for 2008.

Covering new territory for ECS, the Board of Directors approved a broad set of goals that will be the basis behind a rationale for supporting the Society and drive the new

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development initiative. This past spring, the Society hired a Director of Development, Troy M. Miller, to help ECS establish and develop a fundraising program to obtain the additional financial resources needed for the Society to expand and maintain its programs. The rationale for support, or **CASE FOR SUPPORT**, will be used to provide an overview of the Society (its history and success), define the organizational opportunities (goals identified by volunteer leadership), and set out the strategies needed to achieve these goals.

These initial goals have already been identified by various Society committees, are already underway, or already have been approved by the Board of Directors. Among these goals are the following: to understand and respond to the changing needs of the meeting community; to create an online archive of ECS publications; to support and further develop rapid, dynamic, and interactive technical journals; to increase ECS educational and training opportunities; to advocate solid-state and electrochemical research and careers; and to enhance our relationship

with organizations by offering meaningful institutional benefits.

Executive Director Roque Calvo said, "ECS, on the eve of its Centennial year, can view its past successes with pride. The Society has the obligation to take its excellent programs into the next century of the organization and ensure that they meet the needs of members and those in the larger ECS community. These fundraising and development activities will enable us to build on existing programs and help seed new initiatives." ■

These meeting highlights were written by Krishnan Rajeshwar and Mary Yess, Interface's Editor and Managing Editor, respectively.