

Highlights from PRiME 2008

A record number of papers (3,237) and a record number of attendees (over 3,500) marked this fifth edition of **PRiME** (the Pacific Rim Meeting on Electrochemical and Solid-State Science)—the most successful meeting ever held in the discipline. At its début in 1987, this jointly-sponsored meeting had yet to earn its nick-name of “PRiME.” That moniker was developed as it became clear that not only were ECS and The Electrochemical Society

of Japan (ECSJ) eager to share their knowledge and ideas; but other Pacific Rim societies became involved: Japan Society of Applied Physics (JSAP), the Korean Electrochemical Society (KECS), the Electrochemistry Division of the Royal Australian Chemical Society (RACI), and in 2008, the Chinese Society of Electrochemistry (CSE).

A number of technical and non-technical events made the meeting not only an opportunity for technical

discussions, but for networking and socializing as well. The Thursday evening luau was a banquet of sounds, sights, and tastes: Hawaiian music, dance performances, and food, on a perfect night, made for a happy group of 600-plus revelers. Presidents of ECS and ECSJ arrived by ceremonial canoe and good-naturedly joined in the fun on stage. (See the many photos accompanying this story.)

Replicating the success of the first ECS Student Mixer at the ECS meeting in Phoenix in May, over 200 students and others gathered poolside for snacks on Sunday afternoon. Students from as far away as the United Kingdom, Japan, Canada, and Australia traveled across the globe for PRiME and were given the opportunity to network with other students and members before the hectic week began. Bosch, Metrohm USA (formerly Brinkmann Instruments), and Dow all sponsored this successful event.



PRiME 2008 officially opened on Monday, October 13 with the Plenary Session. Preparing for the opening greetings were (left to right): ECS Senior Vice-President **PAUL NATISHAN**, ECS President **NOEL BUCKLEY**, ECSJ President **MAKOTO YODA**, and ECS Executive Director **ROQUE CALVO**.



TETSUYA OSAKA presented the plenary lecture to the opening session of **PRiME 2008**. The fascinating, broad-ranging lecture was entitled, “New Developments in Electrochemical Nanotechnology.”

Electrochemical Nanotechnology

The plenary session lecture, given by **TETSUYA OSAKA** to a packed Monday morning audience, was entitled, “New Developments in Electrochemical Nanotechnology.” Tetsuya Osaka is a professor in the Department of Applied Chemistry at Waseda University, Japan, a position he has held since 1986. He is also currently President of the Magnetics Society of Japan and he previously served as President of ECSJ, and President of the Japan Institute of Electronic Packaging. During his illustrious career, Prof. Osaka has garnered many awards including recognitions from the International Society of Electrochemistry (Pergamon Electrochimica Acta Gold Medal, 1998) and ECS (Research Award of the Electrodeposition Division, 1996).

The talk was organized into four topics focusing on electrodeposition and electroless deposition, micro- and biosensors, the use of nanoparticles for magnetic and other applications, and finally some examples of work on energy conversion problems. The overarching theme of this lecture was that highly functional materials can be created by controlling the electrode-electrolyte interface. Examples based on underpotential deposition (UPD) phenomena and the role of organic additives in film deposition morphology and dynamics are familiar themes to members of the electrodeposition community. On the other hand, control

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Accepting the **2008 ECS EDWARD G. ACHESON AWARD** on behalf of **ROBERT P. FRANKENTHAL** was **JERRY FRANKEL** (right). ECS President **NOEL BUCKLEY** (left) presented him with the Acheson Medal, to be delivered to Dr. Frankenthal at a later date.

of the interface at an atomic or molecular level, especially for applications related to magnetic recording media (work done in collaboration with NTT and NEC in Japan), enhances the capabilities of this film deposition strategy for securing shrinkage of core length and ultra-small recording head dimensions. Examples in microelectronics, for example, involving the Damascene process for Cu interconnects, were also given.

The talk then turned to sensors using self-assembled monolayers (SAMs) on electrode surfaces as a unifying strategy. Thus the development of a micro pH sensor based on a SAM-modified field effect transistor (FET) provides shrinkage of the sensor device to 740 micrometers, as compared with millimeter-size commercial prototypes. Other sensor examples included chirality-sensing using a SAM and copper UPD layer on gold surface and the development of a label-free biosensor also based on a SAM-modified FET device.

A related aspect is the use of nanoparticles (NPs) both for magnetic recording devices and for bio-sensing applications. Thus CoPt nanodot arrays and FePt NPs allow for vertical orientation of magnetization and lead to bit-patterned media fabrication. The SAMs are used for attaching the NPs to targeted surfaces and the use of ionic liquids allow for preparing NPs with tunable and monodisperse size distribution control. The biomedical applications of such magnetic NPs allow for magnetic biosensing and for providing contrast media for magnetic resonance imaging. An intriguing application is cancer therapy where

the magnetic NPs accumulate on tumor cells allowing for their specific and localized destruction by thermal means.

The final topic of this fast-paced lecture was on energy conversion. A micro-fuel cell involving no membrane, based on electrodeposited Pd-Co electrocatalyst as the cathode and Pt-Ru bimetallic catalysts as the anode, was first described for methanol oxidation (*J. Am. Chem. Soc.*, **130**, 10456 (2008)). There is much current interest in finding a high temperature membrane for fuel cells as a substitute for Nafion®. In this vein, a NP-based solid electrolyte was described. Finally, a mesoporous Sn anode for Li ion battery application was discussed. The lyotropic liquid crystal morphology of this novel electrode (*Electrochem. Solid-State Lett.*, **10**, A70 (2007)) aids in relieving mechanical stress during charge/discharge cycles of the battery.

The breadth of the plenary talk was most impressive and the speaker concluded his lecture by pointing out that research has to contribute to increased wisdom for mankind and must also improve the quality of life. He framed these R&D requisites with impressive works of art and quotes from the masters.

Passive Films: Their Growth and Properties

The ECS 2008 Edward Goodrich Acheson awardee, **ROBERT P. FRANKENTHAL**, was introduced by Jerry Frankel (Ohio State University), who pointed out that Bob could not unfortunately make the trip to Hawaii because of doctor's orders. After completing his PhD in electroanalytical chemistry (with Irv Shain) at the University of Wisconsin, Bob joined U.S. Steel Corp., and for sixteen years studied primarily the passivity and localized corrosion of iron and ferrous materials. A 24-year distinguished career at Bell Laboratories (now part of Lucent Technologies) followed resulting in more than 100 publications and 8 patents. He retired in 1996. Of course, Bob is no stranger to the ECS membership, having been a member since 1956, and serving it at all levels culminating as the ECS President in 1993-1994. He was elected an ECS Fellow in 1995 and an ECS Honorary Member in 2003. He has also won other prestigious awards within the corrosion community and has been active in various elected and appointed positions in other societies, notably for example, having served as the Editor-in-Chief of the *Journal of Materials Research* of the Materials Research Society from 1998 to 2001.



ECS President **NOEL BUCKLEY** (front row, center) with the **2008 CLASS OF ECS FELLOWS**. In the front row, from left to right, are: **GERY STAFFORD**, (President Buckley), and **THOMAS THUNDAT**. In the back row, from left to right, are: **JOSEPH STETTER**, **JOHN STICKNEY**, **PATRIK SCHMUKI**, and **CURTIS F. HOLMES**. Missing from the photo are ECS Fellows **DORON AURBACH**, **ALBERT J. FRY**, **FERNANDO GARZON**, **YURY GOGOTSI**, and **PRASHANT V. KAMAT**.

As one testimony to the very high esteem and affection with which the ECS members hold Bob, the symposium room was packed for his award lecture on Monday afternoon. As a first in ECS meeting annals (at least, spanning some three decades of meeting history, this writer (KR) does not recall a similar format), the talk was “beamed” via telephone from New Jersey while Jerry Frankel expertly flipped the slides with prompts from the long-distance speaker! The lecture focused on four aspects of Bob’s corrosion work at Bell Labs and he started off by joking that it was most appropriate that the talk was facilitated by the telephone—underlying the legacy of Alexander Graham Bell and AT&T in this communication technology.

After thanking the award committee and the members of the audience, Dr. Frankenthal began his talk with a summary of his study on the oxidation of a Ni-P alloy. The oxidation behavior at two temperatures (200°C and 300°C) was compared and contrasted both in terms of the surface layers and growth kinetics. The use of surface analysis techniques, coupled with depth profiling, proved most useful for this study.

The second topic concerned the then-little understood mechanistic aspects of the passivity of gold in aqueous sulfate- and chloride-containing media. The passivation process was studied by polarization and gravimetric measurements. An active-passive transition was observed in both media while gold was found to oxidize even in the absence of chloride at high polarization potentials.

The passive film formation was found to decrease with increasing chloride levels in the medium.

The third topic was an example of failure analysis discussed as a typical example of industrial R&D. The “post-mortem” involved a silicon chip with a Cr-containing metallization layer supposed to have been hermetically sealed in a steel can with “dry” nitrogen. Moisture diffusion through defects in the Cr-overlayer was found to be the culprit. This corrosion was DC-current activated and resulted in the formation of a chromium oxide layer 50-80 nm thick. The moisture content in the can decreased with the oxide formation and kinetics analyses of oxide layer growth as a function of temperature (Arrhenius rate law) resulted in activation energy values only ca. 0.4 eV compared with the 1.5-2.0 eV usually observed for

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On behalf of Lawrence Berkeley National Laboratory, an ECS Corporate Member for 5 years, **JOHN NEWMAN** (right) received a Bronze Level Leadership Circle Award from ECS President **NOEL BUCKLEY**.



YANG SHAO-HORN (left) received the 2008 ECS Charles W. Tobias Young Investigator Award from ECS President **NOEL BUCKLEY**.



The **PRiME 2008** LUAU was “called to order.”



Arriving in style: ECSJ President-elect **KENICHIRO OTA** (back) and ECS President **NOEL BUCKLEY** (front).

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such processes. A two-stage mechanism was consistent with the observed data trends.

The last topic was on the oxidation of a Fe-Tb alloy. Amorphous thin films of this material are relevant to high density magneto-optic recording devices. The kinetics and mechanism of the air oxidation of a 500 nm film of $\alpha\text{-Fe}_{0.74}\text{Tb}_{0.26}$ was studied both at room temperature and at 200°C by Auger electron spectroscopy combined with

depth profiling. At room temperature a passivating duplex film, Fe_2O_3 (2 nm)/ Tb_2O_3 (6 nm), formed. At the higher temperature internal oxidation of Tb occurred, enriching the alloy in Fe, took place. Further growth of room temperature duplex oxide only occurred after this internal oxidation of the alloy was complete.

All in all, this talk was most impressive for its clarity; even someone from outside of the corrosion community (like this reporter) could take away

invaluable lessons on the study of interfacial phenomena. I wonder how many people in the audience had to be constantly reminded that the speaker was not even present in the lecture hall; certainly, the clarity of the talk did not suffer at all from this fact. ■

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



The **PRIME 2008** luau was a feast for the senses with Hawaiian music and a dazzling display of traditional dances. It also included some good-natured audience participation.