ECS Cleveland Section and Yeager Center Form Student Chapter

ECS Secretary Petr Vanýsek (right) and Tom Kalapos, chair of the new joint student chapter of the ECS Cleveland Section and YCES.

On December 16, 2004, the ECS Cleveland Section and the Yeager Center for Electrochemical Sciences (YCES) co-sponsored a student poster competition/catered dinner in the new Hovorka Atrium at Case Western Reserve University (Case). The event was very well attended (35 students and 30 professionals/faculty) with 18 posters being displayed. Three students were selected to give oral presentations by the judging committee composed of Dick Middaugh (Energizer), Kathy Ayers (Energizer), Suha Yazici (GrafTech), and Vadim Lvovich (Lubrizol).

The committee awarded the grand prize, a trip to the ECS spring meeting in Québec City, Canada, to Mr. Rohan Akolkar of the Department of Chemical Engineering at Case for his poster presentation "Bottom Up Fill During Copper Metallization of Semiconductor Interconnects." The runners-up were Mr. Jean Boutros (Department of Chemistry, Cleveland State University, OH) for "Electron Transfer and Nitric Oxide Biosynthesis in NOS Enzymes," and Mr. Sergio Granados-Focil (Department of Macromolecular Science and Engineering, Case) for "Poly-phenylene Sulfonic Acid and Its Copolymers as Versatile PEM Membranes."

On February 18, 2005 the Section and YCES hosted an international mini-symposium at Case featuring three preeminent researchers. Petr Vanýsek, professor in the Department of Chemistry and Biochemistry, Northern Illinois University, and Secretary of ECS, presented a talk entitled "Liquid-liquid Interfaces: Electrochemistry Without Redox: Interfaces Between Immiscible Electrolytes." Dr. Vanýsek also gave a pre-symposium seminar and led an informal discussion on impedance spectroscopy. Karl Kordesch (Technical University, Graz, Austria) presented a broad comparison of fuel cell technologies including a short historic survey and present outlook. He also discussed the topic of "Alkaline Fuel Cell-Battery Hybrid Systems with Ammonia Cracker as H_2-Source." The third speaker was Susana Cordoba de Torresi (University of Sao Paulo, Brazil) who gave a fascinating presentation "On the Synthesis, Characterization, and Immobilization of Nanoparticles for Sensing and Display Devices."

After an overview of the state of The Electrochemical Society, its goals, budget, and operations, Prof. Vanýsek proceeded to install the joint student chapter of the ECS Cleveland Section and YCES. The joint student chapter seeks to foster strong interactions between faculty and students from academic institutions in the greater Cleveland area and thus create a strong and active group that will serve as a grass-roots foundation for promoting electrochemistry in the northern Ohio region. Initial participants represent close to ten research laboratories and over 40 graduate and undergraduate students involved in electrochemistry. The officers of the chapter are Tom Kalapos, Chair (Case Western Reserve University); John Moran, Vice-Chair (Cleveland State University); Simona Palencsar, Secretary (Case); and Berryinne Chou, Treasurer (Case). Faculty advisors are Mekki Bayachou (CSU), James D. Burgess (Case/YCES), and Yuryi Tolmachev (Kent State University). The event was attended by 79 industrial participants, faculty, and students. The day concluded with a catered dinner.

This year's distinguished lecturer of the Women in Electrochemistry series was Viola Birss (Department of Chemistry, University of Calgary, Canada). Dr. Birss's visit was co-sponsored by the NSF ADVANCE program at Case. Prof. Birss delivered two technical lectures highlighting her research contributions to the fields of fuel cells and electrocatalysis. The first lecture, entitled, "The Oxygen Electrode in Fuel Cells: It's Not Just Hot Air!", focused on the evaluation and enhancement of the kinetics of the oxygen reduction reaction at solid oxide fuel cell (SOFC) cathodes, involving particularly Mn-oxide and other perovskite materials. In the second lecture, "Ir and Pt Nanoparticles as Electrode Materials: Nanoscale but Megapotential," Dr. Birss summarized recent advances in the synthesis and electrochemical characterization of Ir and Pt Nanoparticles, particularly for the oxidation of methanol at room temperature. In addition, Prof. Birss presented a general audience lecture entitled "Women in Science and Engineering: Are We Making Progress?" focusing on recent trends in the representation of women in the science disciplines, and discussed some of the key factors that continue to dissuade women from taking on these positions.

On April 11, 2005, the ECS Cleveland Section/YCES joint student chapter held a student poster competition, following the first lecture by Prof. Birss. Seventeen posters were presented spanning a diverse array of electrochemical research at both Case and Cleveland Sate University (CSU). Michael Garrels (Department of Materials Science and Engineering, Case) was named the winner by the judges and will receive a $300 cash prize for his work on "Development of Sulfur Tolerant Oxide Fuel Cell Systems." Vidhya Chakrapani (Department of Chemical Engineering, Case) was the runner-up with "Diamond Surface Conductivity: Basis for a Novel Class of Sensors." The day concluded with a catered dinner.

More information about the Cleveland Section, including past and upcoming events, can be found at http://home.cwru.edu/~hbm/ecs/ecslocal.htm.

Council of Section Officers

Don Gervasio, chair of the Council, is presently an Associate Research Professor at the Center for Applied NanoBioScience at Arizona State University. Dr. Gervasio studied chemistry at Pennsylvania State University (BS) and at Case Western Reserve University (MS and PhD) with main emphasis on the syntheses of organometallic and coordination compounds which are redox and often catalytically active. Dr. Gervasio has interest in synthesis, spectroscopy, physical electrochemistry, catalysis, and power sources. Prior academic appointments include Senior Research Associate at the Case Center for Electrochemical Sciences (CCES, now the Yeager Center, YCES) from 1984 to 1993 where he was the lead participant in the study of ion conduction, adsorption, gas solubility, and stability of liquid and solid acid electrolytes for making improved fuel cells. Other involvements included research on the mechanisms and catalyses of electrochemical reactions; hydrogen absorption and permeation in metals; electrochemical sensors and biosensors; and the corrosion of materials, particularly the disbonding of protective coatings under cathodic protection.

Dr. Gervasio was an instructor at Case Western Reserve (1984) and lecturer at Cleveland State University (1987). In July of 1993, he joined the Red Bank Research Company, a joint venture of Motorola and Bellcore (now Telcordia), to develop new membrane and catalyst materials for a mixed-fuel-oxidant-fed, thin film fuel cell (TFFC). During this time, the TFFC was developed from a laboratory curiosity to a device showing potential for commercialization. From December of 1997 to March of 2003, Dr. Gervasio worked at Motorola Labs located in Tempe, AZ to work on fuel cells as long lived electrical power supplies for personal portable applications. In March 2003, he joined Arizona State University and continues to work on fuel cells for portable power and catalysts used in fuel cells, sensors, and microchemical reactors.

Dr. Gervasio is the author of over 30 papers in peer-reviewed publications, has five patents under submission, and has often been an invited speaker at universities, technical societies, and community groups. He may be reached at Don.Gervasio@asu.edu.

Venkat Srinivasan, vice-chair of the Council, received his bachelors in electrochemical engineering from the Central Electrochemical Research Institute (CECRI) in Karaikudi, India, in 1995 and his PhD from the University of South Carolina in chemical engineering in 2000. His thesis topic included various aspects in electrochemical capacitors and the nickel hydroxide electrode. He then worked as a research associate at the Department of Mechanical and Nuclear Engineering at Penn State University for 18 months where he was involved with projects in lead-acid, alkaline, Ni-MH, and Li-ion batteries. Subsequently he moved to the Lawrence Berkeley National Laboratory/University of California at Berkeley as a postdoc working on modeling iron phosphate-based Li-ion cells. Dr. Srinivasan is now a scientist at the Lawrence Berkeley National Laboratory where he contributes toward solving the multitude of problems that prevent Li-ion batteries from being used in hybrid electric vehicles.

Dr. Srinivasan's research interest is primarily in the field of energy storage devices (batteries and capacitors) where he uses both theoretical and experimental techniques to understand their behavior. His approach spans both fundamental and applied aspects of their operation. He also maintains an active interest in the electrochemical processes that are used in the semiconductor industry.

Dr. Srinivasan is a regular contributor to Tech Highlights (featured in Interface) and was author of the Industrial Electrolysis and Electrochemical Engineering report for 2002 and 2003. He can be reached at Vsrinivasan@lbl.gov.

Lawrence Bottomley, secretary of the Council, received his bachelor's degree in chemistry from California State University at Fullerton, in 1976 and his PhD in analytical chemistry from the University of Houston in 1980. He worked for Florida State University from 1980 to 1983. Subsequently he moved to Georgia Institute of Technology, where he is currently a professor of chemistry, Director of Undergraduate Studies, and the Director of Teaching Effectiveness in the School of Chemistry and Biochemistry. While at Georgia Tech Dr. Bottomley was also Director of Graduate Studies. His administrative experience also includes being Vice President for Research of Protiveris, Inc.

Dr. Bottomley's areas of interest include scanning probe microscopy, electroanalytical chemistry, mechanical properties of single molecules, microcantilever sensor arrays, drug-DNA interactions, and nitrogen atom transfer chemistry. To date he has had 125 papers published and has five patents pending.

An active member of The Electrochemical Society, Dr. Bottomley was the founding member of the Georgia Section. He is also a member of the American Chemical Society, as well as the Society of Electroanalytical Chemists, where he serves on the Board of Directors. When not working and researching Dr. Bottomley enjoys spending time with his wife and four children. He can be reached at lawrence.bottomley@chemistry.gatech.edu.

Chicago

The Chicago Section held an after dinner meeting this past May in Peoria, Illinois. The meeting featured three individual subjects, covered by two speakers.

A technical talk was presented by Petr Vanýsek, Northern Illinois University, entitled "Electrochemistry Without Redox: Interfaces Between Immiscible Electrolytes." In it, Dr. Vanýsek discussed the electrochemical behavior of interfaces set up between two immiscible electrolytes. The interfaces have the same diffusion controlled charge transport as known for metals immersed in electrolytes. The fundamental difference between the two systems is that, whereas the metal/electrolyte interface is the site of a redox process, the liquid interface allows ions to pass through, without the redox process ever taking place. The liquid/liquid interfaces have been studied for the purpose of analytical chemistry as well as for structural studies. The interfacial structure has been elusive for a long time, until X-ray studies became possible. The use of X-ray reflectivity to probe the electron density profile normal to the interface between two polar liquids has been demonstrated.

Cory DiCarlo, USDA Peoria gave a talk on "Unexpected Retention of Electrostatically Adsorbed Cytochrome *c* in High Ionic Strength Solutions." In it, Dr. DiCarlo discussed how immobilization of proteins onto various modified electrode surfaces has provided the opportunity to investigate many protein properties such as electron transfer kinetics and redox thermodynamics. In addition, immobilized protein systems have been increasingly investigated as platforms for bioelectrocatalyic processes and sensor development. Due to several factors, including the relative ease of the immobilization process, cyt-*c* is one of the most studied of the protein-alkanethiol systems. In most cases, the cyt-*c* is either electrostatically adsorbed or covalently immobilized to an alkanethiol modified electrode surface. The success of that immobilization is frequently determined through electrochemical means such as cyclic voltammetry (CV). Covalent immobilization requires a rinsing step involving a high ionic strength solution, which is intended to remove electrostatically adsorbed protein and leave only covalently attached protein on the electrode surface. In this study, however, electrostatically adsorbed cyt-*c* was found to be retained after rinsing with high ionic strength solutions. Of concern is the observation of a temporary inactivation of the cyt-*c* redox signal after exposure to high ionic strength solutions, as measured by CV, which may be misconstrued for the desorption of cyt-*c* from the electrode.

Dr. Vanýsek, ECS Secretary, gave an overview of recent activities and status of the Society. He also presented the future plans for symposia and meetings, as well as the outcome and goals of the Centennial Campaign. Dr. Vanýsek also welcomed the lone student in the audience, and stressed the importance of student participation.

Detroit

The Detroit Section met this past March in Warren, Michigan, and the meeting featured Dennis Corrigan, President of Ovonic Fuel Cell Company. His talk, entitled "Ovonic Fuel Cell, a Hybrid Device that Operates Also as a Battery," detailed how the fuel cell system utilizes hydrogen storage materials in the anode, which acts as a catalyst for hydrogen oxidation and as a charge-storage medium. This process enables the storage of regenerative braking energy within the fuel cell stack without the use of a separate battery. Additionally, the energy storage functionality provides for instant-start on the order of microseconds. This fuel cell has excellent cold temperature performance and operates down to -20 degrees Celsius.

European

The Section plans to extend their sponsorship to *UK Electrochem* in Newcastle in September 2005 and to the first ECHEMS meeting, *Electrochemistry in Nanosciences*, which will be held on the Isola di San Servolo (near Venice, Italy) from June 30 to July 3, 2005.

The Section elected new officers at the last meeting in Honolulu, Hawaii: Pawel Kulesza, Chair; Claude Levy-Clement, Vice-Chair; Carmel Breslin, Secretary/Treasurer; Pankaj Agarwal, Councilor; and Dave Walton, Councilor.

New England

The New England Section held a meeting at Northeastern University, in Boston, MA, this past February. The featured speaker was Madis Raukas of Osram Sylvania Central Research Center.

The featured presentation was "Recent Advances in Light Emitting Materials." Materials chosen for discussion included materials found in general and specialty lighting, signaling equipments, and computer displays. Topics explored included some recent developments such as quantum cutting in multi-photon phosphors, luminescent materials for long wavelength excitation in LEDs, quantum confinement phenomena, and newer storage and uses for phosphors.

In March, the Section held a dinner meeting, again at Northeastern University. The featured speaker was Sanjeev Mukerjee, of the Northeastern University Chemistry Department. Mukerjee focused on "Electrocatalysis of PEM Fuel Cell Reactions."
The promise of Proton Exchange Membrane Fuel Cells (PEMFCs) depends upon the design of better electrocatalysts for both anode and cathode electrode processes. After a thorough introduction to PEMFCs the speaker concentrated on his own group's efforts to gain insight into the nature of the four electron oxygen reduction process using a combination of theory and experiment (classical electrochemistry and synchrotron based *in situ* x-ray absorption spectroscopy). Recent results with a new electrocatalyst system for reformate fed anode electrode kinetics were also discussed.

In April the Section held its seventh dinner meeting of the 2004-05 season at the Eagen Research Center of Northeastern University, Boston, MA. The featured speaker was Tayhas Palmore, of the Brown University Materials Engineering Department. The topic presented was, "Recent Advances in Biofuel Cells."

Certain miniature fuel cells–biofuel cells–powered by glucose and oxygen, are expected to be able to power portable electronic devices, remote sensors, and medical implants. Some of these fuel cells have been built, which use glucose oxidase as the anodic catalyst and bilirubin oxidase as the cathodic catalyst, for the production of carbon dioxide and water without formation of peroxides. The presentation emphasized the role of redox mediators in transporting electrons to and from the anode and cathode. Enzyme engineering such as site-directed mutations has been carried out. Dr. Palmore outlined a number of problems currently under investigation to develop a biofuel cell as a power supply for implanted medical devices.

San Francisco

The San Francisco Section had a joint meeting this past January with NACE. Thomas Devine, Department of Material Science, UC Berkeley, gave a talk on "Corrosion-Related Failures in the Home." Devine was able to compare abstract concepts with examples from everyday life. One topic was rusty nails in plywood. Lumber is floated in river for transportation after harvest and the chloride in water accumulates in the lumber. Plywood made from such lumber has high chloride content, which causes the corrosion of nails in it. Another topic was sulfate attack on concrete: Sodium sulfate from soil seeps into the pores of concrete foundations of houses. The volume change of hydration and dehydration of sodium sulfate causes the concrete to crack. Leaky fire sprinklers were another interesting problem caused by cracks developing in the bronze valve. The cracks were caused by bacteria, and can be eliminated by chlorinating the water. Finally, he discussed bad smoke detectors. He noted that a smoke detector has a contact between stainless steel and silver. The small movements between the two parts cause the stainless steel to scrape off corrosion product from silver. Fresh surface is exposed and corrosion continues. The build up of the corrosion product caused the failure of the contact.

In February, the Section heard J. Anand Subramony, of Alza Corporation, give a talk on "Inotophoresis: Electrochemical Methods for Drug Delivery." Subramony explained that iontophoresis was a method of transporting a drug through skin by the application of an electric current. Compared with passive patches, iontophoresis is better controlled, and can deliver a higher flux. In an inotophoretic device, there are two gel patches contacting the skin, each with an electrode backing. One patch is the drug reservoir and the other provides a return circuit. When a current (in micro-amps) is applied, the drug molecule is transported across the skin. The technology requires knowledge of polymer science, electrochemistry, physiology, medicinal chemistry, and pharmacokinetics. This technology is of great interest because in many cases, it can replace intravenous injection, providing a non-invasive way to administer drugs. Several commercial iontophoresis products are available for topical use. Products for systematic pain control are in clinical trials and should be available soon. Iontophoresis can also be used for diagnostics such as in glucose sensing. In this case, it extracts body fluids through the skin to be analyzed. Throughout the talk, Dr. Subramony showed many photos of actual devices. The audience was impressed by the rapid advancement of this new technology.

The Section also held a meeting this past March, and Dr. Robert Kostecki, Staff Scientist at Lawrence Berkeley National Laboratory, gave a talk on "Micro-batteries for Integrated Autonomous Microdevices."

Kostecki said that the greatest obstacle for autonomous microelectronic systems is the lack of suitable power sources. Traditional batteries cannot be scaled down to the required size (<0.1mm). New approaches are needed to solve this obstacle. The thin film battery approach is most compatible with semiconductor processes, but the thin film battery is two dimensional and lacks sufficient capacity. Another approach is to build carbon electrodes with a three-dimensional structure using photolithography or laser direct writing; however, it is difficult to obtain the graphitic carbon desirable for lithium ion chemistry. The third and possibly the most successful approach Kostecki suggested, which is being actively researched, is to use a combination of laser direct writing and traditional battery material in the particulate form. The audience was very curious about when a particular micro-battery will be available. ■