

The IE&EE Division

by Peter C. Foller

Industrial Electrolysis and Electrochemical Engineering (IE&EE) is pleased to be the featured Division in this issue of *Interface*. The opportunity last came in 1994 and 1998. We would like to take this opportunity to describe the Division and illustrate some of the ways in which our activities contribute to the Society.

We are a community of around 600 Society members who have expressed interest in IE&EE as their primary Division. Better yet, counting both first and second choices, the Division has attracted around 1,200 people.

The IE&EE Division was founded in 1943, as an outgrowth of the Society's Chlor-Alkali Technical Committee. By 1990, it was clear that the name of the Division should also reflect a good home for the emerging academic discipline of electrochemical engineering. The latter has developed as a specialty within a limited number of chemical engineering departments and numerous of its leading exponents have been and are very active within our Division.

As time has progressed, a great deal of the technologies, for which the Division was founded as a forum, have matured. Indeed, they have matured so well that significant further technical innovation in these somewhat reluctant to change, heavily capital intensive industries, is either unlikely, or where opportunities do exist, change is not being pursued due to consistently difficult economic conditions. Because of this, we have seen some membership drop off in the U.S. industrial sector. However, we have seen some growth in the academic sector due to the above evolution in the material the Division addresses. Simultaneously with this transformation, we have also seen the Society becoming more international in character. European and Far Eastern companies appear to be more willing to invest in developing technologies for the next cycle of capital investment and, consequently, we have seen growth in our overseas industrial membership.

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Our Featured Division

Industrial Electrolysis and Electrochemical Engineering Division



Our Featured Division...

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We are pleased to have organized an article in this issue of *Interface* from the chlor-alkali area, reflecting continuing progress in a traditional topic for the Division. In this article, Sajjad Ahmed and this writer (of PPG Industries, Inc.) describe PPG's development of the non-asbestos Tephram* diaphragm for use in diaphragm chlor-alkali cells. Though a solution for the displacement of asbestos from chlor-alkali plants long has been sought, it has only been in recent years that success has been achieved. (This was largely driven by issues related to uncertainties over continued asbestos supply, given pressures in other uses, where airborne particulates can be an environmental health and safety issue.) The article primarily describes the successful, cost saving, conversion of PPG Industries' 1,800 T Cl₂/day "Plant C" Glanor V-1244 diaphragm cell circuit at Lake Charles, Louisiana.

In a second industrially-focused article, John Weidner, Vijay Sethuraman, and John Van Zee (of the Department of Chemical Engineering, University of South Carolina) discuss the engineering and manufacture of membrane/electrode assemblies (MEAs) for proton exchange membrane (PEM) fuel cells. In this article the authors discuss the complexities and trade-offs in the optimization of MEA structures for various potential PEM fuel cell end uses.

Reflecting the role of the academic side of the Division, we also have organized an article in this issue by Tom Chapman and Richard Alkire, which outlines academia's role in the advancement of electrochemical engineering.

Our Scope

IE&EE is a highly interdisciplinary Division. The primary interests of the Division are industrial electrochemistry and electrochemical engineering, and in the academic setting, the evolution of tools for the industry, and the training of our practitioners. However, it is worth reviewing some detail within the total scope, to give the reader a flavor for the territory we try to encompass.

Chlor-alkali has traditionally been a mainstay of the Division and, to this day, remains our most reliably best-selling ECS proceedings volume topic. To this, we might add the related areas of sodium chlorite and sodium chlorate (which provide prime routes to chlorine dioxide, which has gained prominence in paper

and pulp). Branching from here, chemicals synthesis is a prime topic. The manufacture of gases such as hydrogen and oxygen is a traditional IE&EE topic that is taking on renewed importance as infrastructure for the prospective "hydrogen economy," and the topic of fuel cell powered transportation have both taken on increased significance. Fluorine evolution and electrochemical fluorination are themes often revisited in our symposia. Alternative oxidants (ozone, hydrogen peroxide, percompounds, etc.) have occasionally been topics within symposia on chemicals synthesis or on environmental applications of electrochemistry.

Industrial electrode materials and membrane and separator materials for various processes are also frequent symposia topics.

The electrowinning of metals is an area IE&EE has traditionally served. Examples in the molten salt area are aluminum, magnesium, and sodium, while in aqueous media, copper, zinc, and manganese, among others, are examples. Ron Woods (CSIRO, Australia) has been notably active in organizing a series of six successful symposia entitled "Electrochemistry in Minerals and Metals Processing."

We have organized symposia in the electrodeposition of paint. This technology is widely practiced and has become very successful, particularly for automotive and industrial applications, although because of its commercial importance, we have found less willingness on the part of industry to publish and present in recent years.

Environmental processes have played an increasing role in our agenda, from metals removal and recovery from waste streams to oxidative wastewater treatment and various dehalogenation schemes for chloro-organics. In the "energy" area IE&EE has been involved in recent years in fuel cell symposia, redox load leveling schemes, and battery modeling.

We always do a General Session at the spring meetings and it is here that we garner emerging topics such as capacitive deionization, electrohydrolysis, bipolar membrane salt splitting, redox-mediated electrosynthesis, etchant recycle, surface treatments, new industrial electrode materials, and miscellaneous new process technology.

Education in electrochemical engineering bridges the gap between industry and academia. The prime contribution of electrochemical engineering is optimization, not only for energy efficiency, product quality, use of raw materials, but for capital minimization as well. The model-

ing methods our academic side has produced have become increasingly sophisticated. The methods pioneered by our membership have found applicability not only in industrial electrolyzer design, but also in the design of batteries, fuel cells, and membrane processes.

Upcoming Symposia

IE&EE generally organizes or participates in approximately seven to ten symposia per year. Our upcoming symposia reflect the interdisciplinary nature of the Division. We typically serve as lead organizers in spring and we typically co-sponsor, following the lead of other Divisions of the Society, in the fall. We often co-sponsor with, among others, Electrodeposition, Energy Technology, Battery, Organic and Biological Electrochemistry, and Physical Electrochemistry. Simply put, as technologies born into other Divisions mature and enter the industrial world, engineering happens. The core skill set of IE&EE members comes into play in design, modeling for optimization, and the integration into complete fully controlled systems.

To illustrate the diversity of our more recent topics, I would like to review our planning for three upcoming meetings of the Society.

For San Antonio (May 9-14, 2004), we are organizing or co-organizing "Tutorials in Electrochemical Engineering," "Micro-Power Fuel Cells," "Educational Needs and Approaches for Electrochemical Engineering," and "Systems and Integration of Fuel Cells: Tutorials and Practice," as well as a General Session.

For Honolulu (October 3-8, 2004), the joint meeting with the Electrochemical Society of Japan, we are organizing or co-organizing a symposium on "Computational Chemistry" (the second we have done), "Membranes and Separators for Fuel Cells and Batteries," "Battery Modeling," and the "4th International Symposium on PEM Fuel Cells." Also at Honolulu, we are again planning a chlor-alkali symposium, and hope to hear about continuing progress toward the industrial scale use of oxygen depolarized cathodes and toward higher current density cells and membranes of increased life.

For Quebec City (May 15-20, 2005), we are considering, along with other Divisions, the following topics: "Hydrogen Generation," "Micro-Power Fuel Cells: Fabrication Techniques," "Electrolytic Surface Treatments," and a General Session.

* Tephram is a registered trademark of PPG Industries, Inc.

The organization of symposia is probably the prime way in which IE&EE facilitates the exchange and dissemination of knowledge within the Society, but there are others.

The Report of the Electrolytic Industries

One of our long-standing traditions is the annual publication of the "Report of the Electrolytic Industries" in the *Journal of The Electrochemical Society* every fall. Each year, the report is prepared by two authors, one junior and one senior. Each year, the senior author retires, and the junior author moves up; the IE&EE Executive Committee is amazed at how readily we find volunteers to enter the two-year commitment. It is a great way to learn the industry and to serve our community.

The report typically covers the chlor-alkali industry, HCl, salt production, potash, soda ash, sodium chlorate, sodium chlorite, fluorine and fluorinated gases, and metals requiring electrowinning at some point in their production (Al, Be, Cd, Cr, Cu, Na, Li, Mn, Mg, Ti, and Zn). Though it is up to the discretion of the authors as to how broad a scope to take on, the Report of the Electrolytic Industries in recent years has also encompassed the dynamics of the electric power industry, batteries, and fuel cells. The report typically runs approximately 20 pages in the *Journal* and is typically complete with 300 to 400 references. This is a major undertaking and we thank our authors for their diligence, their scope of personal interests, and the judgment they insert. Further, our authors present the report at the Division's annual business meeting in the spring of each year.

This year, Venkat Srinivasan (Lawrence Berkeley Laboratory, Berkeley, CA) and Ludwig Lipp (Fuel Cell Technology, Danbury, CT) were our senior and junior authors. Next year, Weidong An (FMC) picks up the torch as junior author with Ludwig. If you are interested in participation, any of our officers would be pleased to talk to you.

Awards of the IE&EE Division

The Division offers two awards for students and offers a unique team-based award for industrial researchers. Through the Society as a whole, there are awards geared to individual professional achievement in IE&EE's core areas of interest.

The Division offers two student awards that are given annually at the spring meeting of the Society, one of which was endowed by the Dow

Chemical Company around 1990 and one endowed by the Division itself. Both carry a prize of \$1,000 and a plaque. This year's winners were Parthasarathy Gomadam of the University of South Carolina (the IE&EE Student Achievement Award) and Jingxin Zhang of Worcester Polytechnic (the H. H. Dow Memorial Student Achievement Award). Nominations are open from June and are due to the chair by September 15 of each year, prior to the fall meeting. Please see the spring and summer issues of *Interface* or the announcement under IE&EE on the Society's website if interested in responding to future Student Award solicitations.

In addition to the student awards, we also sponsor an award recognizing the development of new technologies by teams of up to six principal contributors. The charter of this award is to recognize "significant advances in industrial electrochemistry." It is called the New Electrochemical Technology Award. This award was also endowed by the Dow Chemical Company and Jim McIntyre, from Dow, did much to get it organized. Nominations are now being sought. Please refer to the solicitation in this issue of *Interface*. The inaugural award was won by Eiji Endo and Makoto Nakao of Asahi Glass in 1999 for the development of energy-saving dispersion-plated cathodes for use in membrane chlor-alkali cells.

The Society offers two other awards, of which IE&EE at least feels some spiritual ownership, though they are administered by the Honors and Awards Committee of the Society. These are the Vittorio de Nora Award, ("for achievements in electrochemical engineering"), the newly endowed \$25,000/year Oronzio de Nora Student Fellowship (for "work in the advancement of industrial electrochemistry"), and the newly endowed Charles W. Tobias Young Investigator Award (for recognizing emerging talent over a broad range of areas within the Society's interest).

The vision and entrepreneurial spirit of the de Nora brothers transformed chlor-alkali anode and cell design technology, while building for themselves (independently!) two major businesses. The late Prof. Tobias was one of our own, having often been credited with the establishment of electrochemical engineering as a unique academic discipline. Recognizing Prof. Tobias's lifelong encouragement and development of well-rounded young talent, the award in his name is to honor an outstanding researcher prior to his or her 36th birthday.

How to Participate

The business of the Division is primarily managed and administered by its officers, presently this writer as Chair, Gautam Pillay (of the Inland Northwest Research Alliance) as Vice-Chair, and Dennie Mah (of DuPont) as Secretary/Treasurer. The three of us are fortunate to have a very active and dedicated Executive Committee that meets every Monday of an ECS meeting at the daunting time of 7:00 AM. Given the hour, we have been offering a full breakfast as inducement to attendance; however, beware: if you do attend, you hazard a minefield when it comes to the assignment of action items!

The officers are elected to two-year terms at the IE&EE Division meeting, which is traditionally conducted in luncheon format in the spring. If the elections of the chair and vice-chair are often unintentionally conducted in the finest Soviet traditions, the entry point into what is typically a six-year cycle (the role of Secretary/Treasurer) can often be contested with good humor and collegial spirit.

The topics we deal with generally focus on future symposia planning but in the end also revolve around good stewardship of our funding. Given modest revenue from interest, Society meetings, and proceedings volumes, we try to exercise our best judgment to support symposia attendance by keynote speakers or needy participants, be they students or otherwise.

If you are interested in getting involved with IE&EE, a great way is to attend our Monday morning Executive Committee meetings. These meetings are open; however, we do like to get a headcount beforehand. We can always use new ideas and the enthusiasm of new participants. You would be most welcome. ■

About the Author

PETER FOLLER is an Associate Director of R&D at PPG Industries and has led R&D on behalf of PPG's Chlor-Alkali and Derivatives business unit. Since 2000, he has led R&D on behalf of Transitions Optical, PPG's joint venture in photochromic ophthalmic lenses with Essilor International of France. He has been an active member of ECS since his graduate school days with the late Prof. C. W. Tobias at the University of California at Berkeley, and is currently the chair of IE&EE Division.