Electrochemical Cells at Our Service

by Gessie M. Brisard

The necessity for the development of new materials is the unceasing requirement for high energy conversion efficiencies as in fuel cells, batteries, and solar cells as well as in industrial electrosynthesis applications. For this reason, a fundamental understanding of many basic and crucial electrocatalytical reactions remains an important issue. The various systems examined in the three feature articles of this issue are of particular technological interest. The most important characteristic is the efficiency of the material used for the electrochemical reactions; but in all of them, detrimental side reactions can occur, such as the poisoning effect caused by irreversible adsorption of products/intermediates of the electrochemical reactions. In this special issue of the ECS Physical and Analytical Electrochemistry Division, we have chosen to focus on the ongoing research by dynamic groups of researchers that aims at developing enabling technologies for the production of renewable and sustainable energy from enzymatic biofuel cells, solar cells, and proton exchange membrane fuel cells.

Physical electrochemistry is a core subject in electrochemistry and analytical methods; characterization techniques are its basic support and many seemingly disparate fields are linked to them. It may be because of this that the marriage of electrochemistry and surface sciences and spectroscopy has been successful! Among these fields, one can think of electrocatalysis, electrodeposition, processes at semiconductor/liquid interfaces, and electrochemical synthesis.

Indeed, the three feature articles could have equally well appeared in the issues of other ECS Divisions (e.g., the Energy Technology Division) because we all have the same common ground and interest, namely, understanding the electrode process and phenomena at the interface regardless of whether this interface is homogenous or heterogeneous. On behalf of the Physical and Analytical Electrochemistry Division, it is my privilege and pleasure to present to you three articles in which the themes of reaction pathways, electron transport, characterization techniques and materials performance, and surface composition feature prominently. The first paper: "Enzymatic Biofuel Cells" by Plamen Atanassov, Chris Apblett, Scott Banta, Susan Brozik, Scott Calabrese-Barton, Michael Cooney, Bor Yann Liaw, Sanjeev Mukerjee, and Shelley D. Minteer deals with the challenges involved in the creation of new bioelectrochemical systems such as biofuel cells.

In the second article, Ravi Subramanian describes the evolution of research in the area of semiconductor-based composite materials for liquid junction photovoltaic applications. In his article entitled "Nanostructured Semiconductor Composites for Solar Cells: Review of Fundamentals, Characterization Tools, and Related Composites," he concludes by saying that "Considering the growth of this area and in the context of our present energy needs, solar photovoltaics can be expected to be a major player in alternate energy solutions in the foreseeable future." It would indeed be nice to see this being realized during our life time!

The third feature article shows us how far we have progressed in understanding catalysis in electrochemical systems. "Integrated Theoretical and Experimental Studies of Fuel Cell Electrocatalysis" by Tom Zawodzinski, Jr., Andrzej Wieckowski, Sanjeev Mukerjee, and Matt Neurock is an overview "on the development, refinement, and application of theoretical tools and experimental methods to interrogate the fundamental processes that control fuel cell systems." ■

About the Author

Gessie Mercédes Brisard received her PhD in electrochemistry in 1990 from the Université de Sherbrooke (Canada). After her post-doctoral studies at Lawrence Berkeley National Laboratory (U.S.) in 1992, she was appointed assistant professor in the chemistry department of the Université de Sherbrooke and became full professor in 2004. She will also be vice-dean of the Faculté des Sciences in Sherbrooke starting this summer. She has developed research programs in the fields of electrocatalysis (namely structure–sensitivity of electroreduction processes) and electroanalytical chemistry. Gessie Brisard has been an active member of ECS since 1989. She chaired the Canadian section of ECS in 1997, and is presently serving as chair of the ECS Physical and Analytical Electrochemistry Division.