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Electrochemistry Special Issue

Richard John[A]

[A] School of Environmental and Applied Sciences, Griffith University, Gold Coast Campus, Gold Coast QLD 9726, Australia. Email: r.john@griffith.edu.au

Open a text-book on Electrochemistry today and the lay reader will be enthused (and perhaps slightly confused) by the exploits of researchers of yesteryear including Faraday, Nernst, Fermi, Cotrell, Butler, and others. Its pages will reveal delightful descriptions of diffusion layers, dielectric constants, and double layers, intermingled with theories on solvation effects, electron transfer, and solid–liquid interfaces. The practical applications chapters will include descriptions of charge storage devices (such as batteries and capacitors), electrowinning of metals, electrosynthesis of polymers, and the voltammetric analysis of trace elements. By the end the reader will have grappled with most of the fundamental concepts underpinning the very essence of electrochemical science—the movement and separation of charge. And since most chemical reactions involve charge transfer, the reader will have been exposed to the very essence of chemistry itself.

The Electrochemistry text-books of tomorrow will, rightfully, be more diverse and interdisciplinary than the very much physical nature of today's texts. This will be particularly true in the chapters on applications. Like their present day counterparts, the content of tomorrow's texts will be based on the research exploits of those in the past (today's researchers). As such, we will read about applications of electrochemistry in areas as diverse as nanotechnology, biochemistry, microbiology, genetics, new materials, molecular biology, and so on; indeed, any field in which the movement and/or separation of charge is important. At the recent Interact 2004 Conference held at the Gold Coast, Australia, electrochemical researchers from around the world presented their latest findings in many of these areas. The Interact event included the 12th Australasian Electrochemistry Conference (12AEC), hosted by the Electrochemical Division of the Royal Australian Chemical Institute (EDRACI). This volume of the *Australian Journal of Chemistry* includes a selection of papers from electrochemical researchers who presented at 12AEC.

The selected papers that appear in this volume involve applications of electrochemistry in microbiology (by means of electrochemically mediated catabolism of yeasts and bacteria), molecular biology (employing DNA hybridization and metal–protein interactions), nanoscale surface modification (through protein adsorption), new materials (involving the conducting polymers polyaniline and polypyrrole), as well as more traditional electrochemical applications in metal deposition and the thermodynamics of solid–solid interfaces.

The application of electrochemistry in the catabolic processes of microorganisms has received considerable renewed interest in the last few years. Of particular interest has been the use of soluble electron mediators to shuttle electrons derived from oxidative catabolic processes to electrode surfaces. While these mediated microbial processes have been predominantly studied employing prokaryote cells (such as bacteria), their use in eukaryote cells has received much less attention. Keith Baronian and his team have addressed this issue with the use of single and double mediator studies on yeast species to determine the mechanisms and sites of interactions of the redox mediators within the catabolic pathways.[1] Neil Pasco and colleagues also report the use of double mediated systems in bacterial cells for the development of a rapid assay for biochemical oxygen demand (BOD).[2] A review of the considerable work carried out worldwide in this field over the last five years is presented by Kristy Morris et al.[3] This review focusses on the use of the ferricyanide ion as the electron mediator and its application to environmental monitoring—particularly for rapid BOD and rapid toxicity assays.

The study of conducting polymers (plastics that conduct electricity!) has been a central theme for many electrochemical researchers over the last decade or more. Ben Mattes and his team at Santa Fe Science and Technology Inc. lead the world in the electrochemical synthesis of polyaniline fibres for 'smart fabric' and 'interactive textile' manufacture. Here they report their latest work on the use of ionic liquids as the electrolyte in polyaniline fibre synthesis.[4] The stress generation from these electromechanical actuators exceeds that of skeletal muscle! Dennis Tallman and colleagues have been studying the electrochemical deposition of conducting polymers at various metal surfaces for some years with an eye on the age-old problem of corrosion protection.[5] In their paper they report on the problems of depositing polypyrrole onto aluminium surfaces (due to the concomitant oxidation of the aluminium electrode) and of the use of an electron mediator which lowers the deposition potential as well as serves as the counter-ion in the polymer structure.

The coupling of electrochemistry and molecular biological techniques also finds prevalence in this volume with the

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following contributions: Elicia Wong and Justin Gooding describe an electrochemical DNA biosensor employing a self-assembled monolayer for the sensitive and selective detection of DNA hybridization;[6] Edith Chow describes the modification of electrode surfaces with oligopeptides for the selective determination of heavy metal ions;[7] while Alison Downard and her team report on their novel approach for electrode modification to enhance protein adsorption.[8]

Finally, no electrochemistry conference would be complete without revisiting some old favourites, but looked at in a new way. Frank Walsh and his colleagues review the latest in the theories and practical implementation of metal deposition at rotating cylinder electrodes before giving their informed view on the future of these techniques.[9] Lastly, Stephen Fletcher mixes it with none other than Gibbs by giving us his account of solid–solid interfaces in systems of fixed mass.[10]

From the EDRACI point of view the 12AEC conference was an outstanding success and I would like to thank all those who participated, with special thanks to those that contributed to this special edition. I hope you enjoy reading about their latest work as much as I enjoyed hearing it first hand. I have no doubt that much of what is presented will find its way into the mainstream electrochemical texts of tomorrow.

Richard John
Chair, EDRACI (2000–2004)

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