

R.C. Alkire, D.M. Kolb, J. Lipkowski, P.N. Ross (eds): Advances in electrochemical science and engineering (vol 10): Electrochemical surface modification

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As the most recent volume of a successful series established by two of the present editors in 1997 in continuation of actually two equally successful enterprises started as one series initially in 1961 already under the present title and edited by P. Delahay and C.W. Tobias and the second series “Frontiers in Electrochemistry” established 1992 by J. Lipkowski and P.N. Ross, this book contains four reviews of very different topics in current electrochemistry. The book’s title “Electrochemical Surface Modification—Thin films, Functionalization and Characterization” is appealing at first glance, but on closer inspection it appears to be an attempt only to highlight the somewhat stressed common aspects of these contributions—and it will be examined below whether these relationships exist indeed.

In the first chapter, A. Michaelis reviews surface layers on/of valve metals, silicon and further ceramics used as dielectric films in electronic devices. At first glance not exactly an electrochemical topic (electrochemists know these layers mostly as passivation layers), but the text impressively reports the numerous places where electrochemistry plays a role in layer formation, characterization and modification of these layers frequently employed in active and passive components in the electronic industry. Carefully and systematically, methods—electrochemical, spectroscopic and microscopic ones—are described and subsequently applied to all relevant oxides. Numerous examples from the electronic industry put the systems, their investigations and their properties into perspective. An impressive and instructive overview of valve metal oxide layers on more than 100 pages. The formation of these

layers mostly proceeds by non-electrochemical methods—thus apparently not exactly something the (sub)title of the book seems to address.

Galvanic metal plating has been a standard technology in the semiconductor industry for quite a while. With growing integration density and more complicated wiring and structures, new processes have come into play. Superconformal film growth, which is of particular importance in the galvanic deposition of copper, is treated by Moffat et al. in the second chapter. Contrary to well-known metal plating, e.g., as used in the making of a master matrix (or stamper) in vinyl record, CD and DVD production where the shape of the metal deposit carefully replicates the substrate surface topography in superconformal deposition, all details of the underlying surface are “buried” with a finally flat and smooth surface. All the considerations previously spent on additives enforcing the true replication are now put on their head. Superconformal filling shows up in the Damascene process, in superfilling and in interchip vias. Even in DVD making, superconformal film growth may lead the way to new applications. As in conventional metal plating, influential process parameters and the effects of additives (levelers, brighteners, accelerators, inhibitors, etc.) are of central importance. They are reviewed and discussed carefully on about 80 carefully illustrated pages.

D.A. Scherson et al. provide an update on transition metal macrocycles as electrocatalysts for dioxygen reduction. This subject has been around for decades, stimulated by the appealing promise to replace costly noble metal catalysts known to be sensitive toward various catalyst poisons by materials somehow mimicking nature. Although impressive results have been obtained with optimized molecules, these catalysts have lacked sufficient stability in practical application, in particular in fuel cell applications and for extended

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operation at high current densities and at elevated temperatures. The wide variability of these molecules both in structural and in chemical terms results in an overwhelming amount of material to be reviewed. Even when limiting oneself to those molecules only which have been tested for electrocatalytic activity, a very wide range of publication remains. Apparently, the authors were not quite sure which approach to take; thus, this contribution oscillates between fundamentals of rotating ring-disc electrodes and thermal activation of metal porphyrines (a nice way to call a process which has been flatly termed pyrolysis for many years). The present reader who is familiar with the subject based on his own extensive research was left somewhat confused; a useful introduction to this topic may look slightly different.

Multiscale modeling and design of electrochemical systems are reviewed by Braatz et al. in the very short final chapter. After some searching, the reader may realize that “systems” designates almost everything from a device or a structure up to a whole process in electrochemistry. Certainly, the rapidly growing power of computers and the development of software to model almost everything provide indeed new possibilities—but, unfortunately, the present reader was left with a diffuse feeling about the usefulness of this contribution.

The book is fairly carefully prepared, but at whatever state of production minor lapses of care happened: In Table 1.1, references stand in for values of ε_p ; in a few cases, pictures were prepared or converted with a rather low resolution. In all cases, there was no big effect on understanding.

The initially stated doubts regarding the coherence of the chapters with respect to the book’s title and subtitle will linger with most readers—as they did with the reviewer. Basically, there is nothing wrong in a successful series like the present one to collect overviews on topics of general interest without forcing them into an artificial relationship. Potential buyers and readers will consider this subtitle merely as a distraction. Because the meaning of surface modification is apparently ill-defined, it is safe to say that all of the chapters are somehow related to a fairly broad range of interpreted meanings of the title—not more. Despite these weaknesses, the book is a must for all libraries already owning previous volumes. In addition, the contributions on the four reviewed topics (except for the last one) themselves justify acquisition for those entering the respective fields, and the editors may return to the good and justified tradition of preparing future books in this series without unnecessary or even misleading (sub)titles.