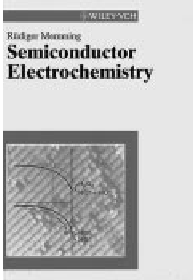
Semiconductor Electrochemistry. By *Rüdiger Memming*. Wiley-VCH, Weinheim 2000. x + 399 pp., hardcover DM 298.00 (ca. 152 €).—ISBN 3-527-40147-X



Semiconductor electrochemistry and photoelectrochemistry developed in interesting ways in the second half of the 20th century. The discovery of the transistor based on Si and Ge single crystals led in the mid-fifties to investigations on Ge and Si electrodes in aqueous electrolyte solutions. A diode function was also found with semiconductor electrodes. However, it soon became clear that interfacial charge-transfer processes were coupled to chemical processes, so that semiconductor/electrolyte diodes are more complex than their all-solid-state counterparts. Relevant in situ investigations of the surface chemical processes were not possible at that time. The understanding of anodic charge transfer and surface chemistry improved considerably in the following decades and led to a large number of wet surface preparation techniques for Si and III–V compound semiconductors, which are still used in industry.

A second remarkable event in the history of semiconductor electrochemistry was the proposal of Fujishima and Honda in 1972 that photoexcited electrons and holes in semiconductors could be used to drive thermodynamically unfavorable electrochemical reactions, such as the conversion of water into hydrogen and oxygen at room temperature. Thus, semiconductor/electrolyte interfaces can be used to convert solar light energy into chemical fuels. In addition, the electrochemical potential of photoexcited electrons and holes in a semiconductor can be used to perform electrical work in an external circuit. The energy crisis in the seventies gave an enormous boost to research on photochemical and photoelectrochemical reactions at single-crystal semiconductor electrodes. Researchers from different disciplines, ranging from solid-state physics to catalysis, were attracted by the well-sponsored field of semiconductor photoelectrochemistry. This interdisciplinary approach of semiconductor electrochemistry has certainly been fruitful, but has also led to much mediocre work and confusion, even where fundamental principles were concerned. Activity gradually decreased during the eighties, and semiconductor electrochemistry became a “normal” scientific discipline. A few years later, however, it was discovered that a single crystal of silicon could be etched anodically to give a nanoporous network with surprising optical properties; this again brought many research groups into the field of semiconductor electrochemistry. At present, many other examples of nanostructured semiconductors and nanometer-sized crystals are being prepared and their surprising optical and electrical properties investigated. Photoelectrochemistry has obtained its own place in this vivid and very multidisciplinary field.

In the book *Semiconductor Electrochemistry*, Rüdiger Memming aims to review the basic principles which are required to understand this field and to perform new research in it. In addition, Memming has put a lot of effort into illustrating these principles by describing scientific results published in the period roughly between 1960 and 1990, when he was an active researcher in the field.

Considering the different scientific approaches and viewpoints that have been used, that is not an easy task. It is necessary to understand how electrons behave in bulk solids and at surfaces and interfaces (Chapters 1 and 2). Liquid solutions with dissolved ions and a redox system form another cornerstone of understanding, as also does the detailed structure of the semiconductor/electrolyte interface (Chapters 3 and 5). The thermodynamics governing the preferred direction of electron transfer, and transport in an electrochemical cell with an illuminated semiconductor electrode, are discussed in detail in several chapters. This is still not enough; the kinetics of electron transfer between a semiconductor and a redox system form a key topic in semiconductor electrochemistry. For a basic understanding, one needs the classical approaches proposed by Marcus and Gerischer, which consider the reorganization of a redox system before electron transfer, and the even more demanding quantum-chemical approaches first proposed by Levich and Doganatze, and now refined by many other theorists. Memming presents the basic principles of all these theories in Chapter 6. This condensed treatment inevitably involves some simplifications; the professional reader should regard this part as only a first encounter with the theory of electron transfer, and should not hesitate to study the original literature in detail. Moreover, Chapter 6 would profit from editing by a scientist working in the field of electron transfer, and by correction of the typing errors in the equations. Unfortunately, typing errors in the equations and sloppy referencing also occur in several other chapters.

Chapter 7 reviews basic research on one-step electron transfer between a semiconductor and a redox system, both in the dark and under illumination. In Chapter 8, more complex charge-transfer processes leading to dissolution of the semiconductor material itself are discussed. This chapter too is quite condensed. Readers who are involved in basic research on complex reactions and applications such as electrochemical surface treatments will need to go back to the original literature. A more extended list of original publications and reviews on this important subject would help. Chapter 9 discusses photoelectrochemical reactions with nanometer-sized semiconductor particles, which can show size-quantization effects. The following chapter discusses photoinduced electron transfer between dye molecules and semiconductors. In the last chapter, potential applications of semiconductor photoelectrodes are discussed.

Who will benefit from reading this book? Graduate students who plan to carry out research in semiconductor electrochemistry can consider this book as a helping hand to bridge the gap between basic textbooks on electrochemistry and physical chemistry and the original literature. Senior researchers will find that the book contains an extensive summary of theories and experimental results dealing with the numerous aspects of semiconductor electrochemistry.

The book deals with almost all aspects of semiconductor electrochemistry, and presents the basic principles, as well as many results from published research. The material that is presented is more comprehensive than in previous books, and also deals with recent new developments, such as size-quantized photoelectrochemical systems and porous dye-sensitized photoelectrochemical solar cells.

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Principles and Applications of Asymmetric Synthesis. By *Guo-Qiang Lin, Yue-Ming Li* and *Albert S. C. Chan*. John Wiley & Sons Ltd., Chichester 2001. xvii + 515 pp., hardcover £ 64.50.—ISBN 0-471-40027-0

It is fair to describe asymmetric synthesis as one of the most important and wide-ranging topics of organic chemistry. An enormous variety of methods has been developed during the last 30 to 40 years, at first mainly stoichiometric reactions, then in the last two decades with an increasing emphasis on catalytic methods. Although a number of books on aspects of asymmetric synthesis, some of them very substantial, have recently appeared, for the last few years there has not been a concise, quickly assimilable, survey of the state of the art in this extensive area of research. The authors of this book have set themselves the demanding task of filling that gap. The material included covers the situation up to September 1999, and thus, notwithstanding the rapid pace of development, it offers an up-to-date view of the field.

The book is intended especially for synthetic chemists and students who use asymmetric synthesis as one of the main methods of their work, and who want an overview of the available techniques. Each chapter contains an exhaustive compilation of literature references, making it very easy to go into topics in more depth.

The first chapter is an introduction, and touches on a wide variety of topics. There is a short discussion of the different types of chirality and their nomenclature, so condensed that the meaning is not always very clear. In contrast, methods for determining enantiomeric excess (*ee*) and absolute configuration, which are of more practical importance in relation to synthesis, are treated in lucid detail. Unfortunately, however, the last part discussing strategies for asymmetric synthesis is less convincing.

The following chapters are arranged rationally according to reaction types: α-alkylations and 1,2-additions to carbonyl compounds, aldol and related reactions, oxidations, Diels–Alder and related reactions, and reductions. These topics are treated in thorough detail, covering not only stoichiometric and auxiliary-based methods but also catalytic methods. The emphasis is not so much on describing a specific reaction with all its variations and finer details, but rather on giving a comprehensive picture of the whole range of possibilities. The individual methods are described briefly but precisely, and numerous literature references are provided for the reader who wishes to go into more depth. Each chapter is written in the style of a review article on the topic concerned. At the end of each chapter there is a very useful table summarizing the most important and effective ligand systems for catalytic reactions, together with relevant literature references. However, the long chapter that follows these descriptions, devoted to the use of asymmetric reactions in natural products syntheses, is rather out of place in a book such as this, which is intended as a work of reference. It consists of over 50 pages describing total syntheses of natural products, including for example rifamycin S and taxol, but without much information on retrosynthetic approaches or on general strategies. The descriptions are limited to the actual reactions used, which is of little use to the synthetic chemist who wishes to learn about general methods. The final chapter is also unsatisfactory and badly structured. It contains brief and inadequate treatments of a very inhomogeneous collection of different topics, ranging through enzymatic reactions, nonlinear effects, autocatalysis, and a variety of reactions, including some important ones that were already very thoroughly studied before 1999, such as asymmetric 1,4-additions. Unfortunately the brief subject index that follows also leaves much to be desired. For example, such important keywords as "Oppolzer sultam", "Oxazolidinones", and "BINAP" are missing.

To summarize, this book provides a concise and fairly comprehensive overview of the most important aspects of asymmetric synthesis, offering the chemist a quick survey of the available methods. However, the content and structure of the last two chapters is not very appropriate for a work of reference. Also the book lacks a thorough and detailed index, which is essential if it is to fulfill its aims effectively.

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