

1

A Reader's Guide to Basic Electrochemistry for Biotechnology

This book on *Basic Electrochemistry for Biotechnology* is meant for readers working in the field of microbial electrochemistry and microbial electrochemical technologies. It is meant for readers with different professional training and scientific backgrounds, who are at different stages of their careers and working on the interface between biotechnology, electrochemistry, and engineering. Because of these different backgrounds and levels of expertise, we have to assume a certain knowledge base. This book explains the basic principles of electrochemistry for people with a background in biotechnology, and therefore we assume a certain level of knowledge in microbiology throughout the book.

The book is structured in such a way that the consecutive chapters provide step-by-step insights into the basics of electrochemistry (Figure 1.1). Chapter 2 introduces microbial electrochemical technologies and illustrates why we, the authors, are so fascinated by working and spending our professional lives at the interface of microbiology and electrochemistry. Chapters 3 and 4 then provide an insight into the thermodynamic fundamentals of electrochemistry, which is followed by an introduction to basic electrochemical methods in Chapter 5. After the details on electrochemical kinetics in Chapter 6, you will learn how to use and understand dynamic electrochemical methods in Chapter 7. Until then, we have focused almost exclusively on individual electrodes (that we call electrochemical half-cells). Yet, full reactors are also of great interest to the community. Thus, we will get a glimpse of how to characterize full electrochemical cells in Chapter 8. In Chapter 9, we provide an outlook on the topics covered in this book, and share considerations on the design and execution of experiments and on reporting results.

We designed the individual chapters in such a way that they can also be used independently, e.g. for addressing one specific aspect or refreshing knowledge. Therefore, for the general convenience of the reader, every chapter starts with its key messages. To provide easy access for the reader and to avoid misinterpretation, the stringent use of symbols and units is essential. All abbreviations are summarized in Appendix A, and used symbols, units, and constants are summarized in Appendix B. Furthermore, we believe that well-designed examples can substantially foster understanding, and since repetition is the mother of learning, we included examples as well as exercises for self-study, with the answers and solutions shown at

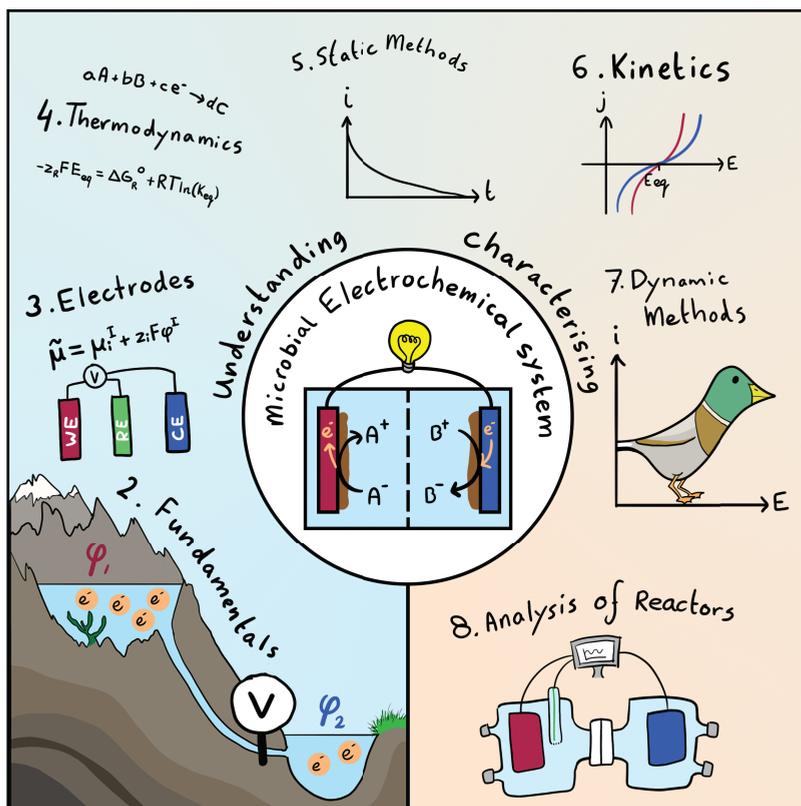


Figure 1.1 Overview of the book's content. We start with the fundamentals of microbial electrochemical technologies (Chapter 2), electrodes (Chapter 3), and thermodynamics (Chapter 4) to provide basic background knowledge on these aspects. With these basics, we discuss static electrochemical methods (Chapter 5) and, from there, move on to electrode kinetics (Chapter 6) and dynamic electrochemical methods (Chapter 7). Finally, we apply this knowledge to the analysis of full electrochemical cells (Chapter 8).

the end of the book (Appendix C), and the needed data summarized in Appendix D. In addition, each chapter includes boxes, which provide additional information on important topics.

The figures in this book are presented as an artistic representation of reality. This means that in some cases, some details might be missing from the representation. Nonetheless, the figures are an accurate description of microbial electrochemical systems and graphs. In the case of graphs, you might notice that units are lacking from the axis. Although this might not be considered good scientific practice to some, this has been done intentionally as in many cases the units can have multiple normalizations. The units of the symbols used in graphs can be found in Appendix B.

There will probably be topics that are relevant for microbial electrochemical systems that are not covered in this book; we did our best to include the background and aspects that we find most important. We hope that you enjoy reading!