

Preface

Biotechnology has become one of the most important technologies in twenty-first century contributing every aspect of our life and industry. Biotechnology can contribute to the problems of our human culture and civilization from health, food, energy, environment, and to materials issues. Biotechnology is therefore playing a key role in pharmaceutical, medical, chemical, electronics, energy, and environment industries.

For the development of biotechnology, deep understanding and fusions in biology, chemistry, enzymology and engineering are required. One fundamental area of biotechnology is enzyme engineering which covers enzymology, enzyme technology, and engineering of enzymes. Enzymes have been used for food preparations such as cheese and alcohols from long time ago. In 1970s, immobilized enzymes have accelerated the development of enzyme engineering. In 1980s, the understanding of enzyme reaction in organic solvent has created a new area in enzyme engineering. Also with the energy and environment crisis, bio-based chemicals and bioenergy have opened a new area in enzyme engineering. With systems biology and metabolic engineering, enzymes for bio-based chemicals including polymers have become more and more important nowadays. Recently with the knowledge on molecular dynamics and quantum mechanics, computational tools have become stronger, which will contribute to the design of novel enzyme in the long run. Cheaper enzymes and more stable enzymes as well as more applications are required for their wide commercial use.

Even though enzymes are becoming more and more important, it is not easy to find a good textbook for the students to study the role of enzymes in biotechnology area, except for handbook style books or books dealing with current issues and specific topics, which gave us an idea to start to write the book, *Fundamentals of Enzyme Engineering*.

This book is written mainly for senior level or graduate students in biotechnology. However, this book can be also used as a guidebook for an overview of enzyme engineering working in relevant industries. This book consists of four

parts with 15 chapters and deals with fundamentals of enzyme chemistry, classical enzyme reaction engineering, recent molecular level understanding of enzyme, and various applications of enzymes.

Even though there are so many research results and industrial experiences reported so far, fundamentals and basic concepts with some cases are introduced and emphasized in the text instead of a knowledge-oriented description of every case of enzyme engineering. For the details or for specific cases, reading and discussion using related references are desirable. Some of which are introduced in the text as case studies and examples. For industry, searching for the patents and discussion based on the patents are also desirable for understanding of the technology and for further development. Since our knowledge and understanding of enzymes is still not enough and many challenges are waiting, further discussions on these issues are therefore presented at the end of each chapter.

For students who are familiar with basic biotechnology including biochemistry and biology, it is recommended to emphasize advanced level and recent advancement of enzyme engineering including molecular understanding and applications which are the integration of diverse principles. Reactor design and optimization which is generally required in industry are not described in detail in this text, which can be supported using the texts on reactor design.

We would like to express our gratitude to many colleagues, friends, students who gave tips, comments, and assistance during the development of this book as well as to the publisher who gave us a chance to publish this book.

We hope this book Fundamentals of Enzyme Engineering can be useful for the students in academia as well as the engineers in industry for the future development of enzyme engineering and biotechnology.

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Fundamentals of Enzyme Engineering

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2017, X, 209 p. 95 illus., 11 illus. in color., Hardcover

ISBN: 978-94-024-1024-2