

Preface

The rapid depletion of petroleum reserves and fossil fuels presents a challenging problem to the world, especially to countries whose industries are heavily reliant on petroleum-based feedstocks. A new industrial trend is to move from petroleum-based to bio-based products and manufacturing processes that can conserve the earth's natural resources and save the planet from industrial pollution. Meanwhile, many industrialized countries, such as the United States, also face the dual problems of surplus agricultural commodities with low economic returns for farmers and large amounts of food processing wastes with high disposal costs because of increasingly tight environmental regulations. The development of a bio-based product industry will offer an economical and environmentally friendly solution to the aforementioned problems.

The oil crisis in the 1970's and the birth of a new biotechnology industry in the early 1980's have given society the hope of becoming fully sustainable by using renewable resources. Since then, many new bio-based products and bioprocessing technologies have been developed. Until recently, however, the biotechnology industry has focused its effort mainly on recombinant protein drugs and transgenic plants and animals. Much less attention has been given to high-volume medium-value industrial products such as oxychemicals, drug intermediates, polymers, industrial solvents, fuels, and food ingredients and feed supplements, although many of these have traditionally been or are currently produced by fermentation from carbohydrate-based feedstocks. The slow progress in commercial development of these bio-based products in the past 20 to 30 years can be attributed to low investment return due to relatively inefficient bioprocesses and steep price competition from the petroleum-based products that dominate the market, and the difficulty of changing the corporate cultures of the traditionally segregated chemical and agricultural industries. This situation has been drastically changed in the last few years. Traditional agricultural companies, including Cargill and ADM, have expanded and transformed from being primarily commodity food/feed suppliers to major manufacturers of value-added products, including specialty chemicals and fuel ethanol. During the same period, several large chemical companies, including DuPont, Dow Chemical, and Monsanto, have also made major R&D investments in biotechnology-based manufacturing processes. This shift toward a bio-based economy has further accelerated as the price of crude oil has been doubled in two years and recently reached US \$70 per barrel, making many bio-based products economically competitive and appealing to corporate and private investors.

This book provides a comprehensive review of the fundamentals of biotechnology and bioprocess engineering as well as industrial examples of new bio-based products and advancements in technology development that are important to the general field of sustainable bioprocessing for value-added industrial products from renewable resources. Critical enabling technologies, from genomics to metabolic and bioprocess engineering, are discussed, with some examples. Both fundamentals and novel developments in biotechnology and bioprocess engineering, and their applications to existing and new bio-based industrial products are described in sufficient

detail to allow both experts and non-experts to comprehend recent progress in this field. This book first discusses the modern technologies in the fields of biotechnology and bioprocess engineering that are the cornerstones for building a new bio-based products industry. The second part of the book reviews different organisms, ranging from bacteria to algae, that are suitable for bioprocessing because of their unique characteristics, process requirements, products, and applications. The third part of the book comprises a variety of unconventional and novel bioprocesses currently in development. Finally, the book provides examples of the economical use of different renewable resources as feedstocks to produce industrial products.

We started this book more than two years ago. The invited contributing authors are leading experts in their respective research field from the USA and other countries. Without their contribution and editorial assistance from Kevin Yang, this book would not have been finished in time for publication.

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