

Preface

The environment pollution and energy crisis are two vital issues for sustainable development worldwide. The use of fossil fuels (petroleum, natural gas, and coal) is considered as the cause of serious environmental problems.

With the increasing demand of energy and depleting reserves of conventional fossil fuels, there has been growing global interest in developing alternative sources of energy. Although hydrogen (H_2) is not a primary energy source, it has been considered a promising candidate as a substitute for fossil fuels because it has the potential to eliminate most of the problems caused by the fossil fuels.

From the perspective of energy source, hydrogen can be produced from organic wastes (agricultural wastes, municipal wastes, algal biomass, etc.), renewable energy (solar, wind, etc.), fossil fuel (coal, oil, natural gas, etc.), and nuclear energy. Different technologies have been used for hydrogen production, such as direct thermal, thermochemical (such as hydrocarbon reforming and coal gasification), electrochemical, and biological. Among the hydrogen production methods, hydrogen production using biological processes is new, innovative, and potentially more efficient, which has been broadly studied for its mild reaction condition and high potential environmental benefits.

Biohydrogen production is performed by hydrogen-producing microorganisms at ambient temperature and pressure. Microorganisms can recover and concentrate the energy from aqueous organic wastes, such as industrial wastewater and sludge. Biohydrogen can be produced from the biophotolysis of water using algae and cyanobacteria, the photo-decomposition of organic compounds by photosynthetic bacteria, and the dark fermentation from organic compounds with anaerobic bacteria. Among these biological processes, dark fermentation is more favorable than photo-dependent hydrogen production for its independency of light, generally high rate of hydrogen generation, simple reactor as well as easy control. In particular considering the wide range of substrates, dual benefits of clean energy generation and organic wastes management can be achieved, since hydrogen is produced from various organic wastes and wastewater enriched with carbohydrates as the substrate, decreasing the cost for hydrogen production. Thus, fermentative hydrogen

production is widely accepted as a more feasible biohydrogen production way, and gained widespread interest and attention.

Biological hydrogen production processes offer a technique through which renewable energy sources like biomass can be utilized for the generation of the cleanest energy carrier. Hydrogen-intensive research work has already been carried out on the advancement of these processes, such as the development of genetically modified microorganism, metabolic engineering, improvement of the reactor designs, use of different solid matrices for the immobilization of whole cells, biochemical-assisted bioreactor, and development of two-stage processes for higher hydrogen production rate.

The present book provides the state-of-the-art information on the status of the biohydrogen production from various organic wastes. This book has eight chapters, including the microbiology, biochemistry and enzymology of biohydrogen production, the enrichment of hydrogen-producing microorganisms, the pretreatment of various organic wastes for hydrogen production, the influence of different physicochemical factors on hydrogen production, the kinetic models and simulation of biological process of fermentative hydrogen production, the optimization of biological hydrogen production process, and the fermentative hydrogen production from sewage sludge.

The text in all the chapters is supported by numerous clear, informative figures and tables. To our knowledge, this book is a first attempt to describe the biological hydrogen production from various organic wastes, which is aimed at a wide range of readers, mainly including undergraduates, postgraduates, energy researchers engineers, and others who are interested in hydrogen production in general and biological hydrogen production in particular, as well as to industrial concerns that are looking for inexpensive hydrogen production technologies.

We warmly thank Dr. Mengchu Huang and Dr. Sivajothi Ganesarathinam, and the team of Springer Nature for their cooperation and efforts in producing this book.

We hope readers will find this book interesting and informative for their research pursuits.

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