

The Handbook of Environmental Chemistry

Volume 104

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In over three decades, *The Handbook of Environmental Chemistry* has established itself as the premier reference source, providing sound and solid knowledge about environmental topics from a chemical perspective. Written by leading experts with practical experience in the field, the series continues to be essential reading for environmental scientists as well as for environmental managers and decision-makers in industry, government, agencies and public-interest groups.

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- remediation and waste characterization
- environmental contaminants
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- chemical reactions and processes
- chemical and biological transformations as well as physical transport of chemicals in the environment
- environmental modeling

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Meeting the needs of the scientific community, publication of volumes in subseries has been discontinued to achieve a broader scope for the series as a whole.

Bioprocess Engineering for Bioremediation

Valorization and Management Techniques

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Series Preface

With remarkable vision, Prof. Otto Hutzinger initiated *The Handbook of Environmental Chemistry* in 1980 and became the founding Editor-in-Chief. At that time, environmental chemistry was an emerging field, aiming at a complete description of the Earth's environment, encompassing the physical, chemical, biological, and geological transformations of chemical substances occurring on a local as well as a global scale. Environmental chemistry was intended to provide an account of the impact of man's activities on the natural environment by describing observed changes.

While a considerable amount of knowledge has been accumulated over the last four decades, as reflected in the more than 150 volumes of *The Handbook of Environmental Chemistry*, there are still many scientific and policy challenges ahead due to the complexity and interdisciplinary nature of the field. The series will therefore continue to provide compilations of current knowledge. Contributions are written by leading experts with practical experience in their fields. *The Handbook of Environmental Chemistry* grows with the increases in our scientific understanding, and provides a valuable source not only for scientists but also for environmental managers and decision-makers. Today, the series covers a broad range of environmental topics from a chemical perspective, including methodological advances in environmental analytical chemistry.

In recent years, there has been a growing tendency to include subject matter of societal relevance in the broad view of environmental chemistry. Topics include life cycle analysis, environmental management, sustainable development, and socio-economic, legal and even political problems, among others. While these topics are of great importance for the development and acceptance of *The Handbook of Environmental Chemistry*, the publisher and Editors-in-Chief have decided to keep the handbook essentially a source of information on "hard sciences" with a particular emphasis on chemistry, but also covering biology, geology, hydrology and engineering as applied to environmental sciences.

The volumes of the series are written at an advanced level, addressing the needs of both researchers and graduate students, as well as of people outside the field of

“pure” chemistry, including those in industry, business, government, research establishments, and public interest groups. It would be very satisfying to see these volumes used as a basis for graduate courses in environmental chemistry. With its high standards of scientific quality and clarity, *The Handbook of Environmental Chemistry* provides a solid basis from which scientists can share their knowledge on the different aspects of environmental problems, presenting a wide spectrum of viewpoints and approaches.

The Handbook of Environmental Chemistry is available both in print and online via www.springerlink.com/content/110354/. Articles are published online as soon as they have been approved for publication. Authors, Volume Editors and Editors-in-Chief are rewarded by the broad acceptance of *The Handbook of Environmental Chemistry* by the scientific community, from whom suggestions for new topics to the Editors-in-Chief are always very welcome.

Damià Barceló
Andrey G. Kostianoy
Series Editors

Preface

The current generation society is moving ahead from the primordial conception of “take, make, and dispose of” to “reuse and recovery” of potentially available resources to attain a “healthy–wealthy environment” and “prospective socioeconomics.” Bioprocessing is a key platform in the establishment of circular bioeconomy through the valorization of biowaste, organic residuals, and bio-industrial side streams into value-added products of low cost and sustainable aspects. Waste biorefinery is gaining more attention nowadays because waste is used as the renewable feedstock for the recovery of bioproducts and bioenergy by means of sustainable biotechnology. The traditional approach of waste management is focused on the removal or reduction of pollutants to protect the environment and mammals from the harmful effects. However, scientific advancement has led to the remediation that can be pursued by using waste as an alternative feedstock toward refining the waste for the recovery of the valuable resource products. In a nutshell, all kinds of wastes including solid, liquid, and gas have inbuilt potential resources that can be valorized for the development of bio-based products and biofuels through an intensive bioprocess cascade system that enables the transformation toward a low-carbon circular bioeconomy. Therefore, circular bioeconomy paves way for the reuse, recycle, and remanufacture via the idea of utilizing the bio-based materials for the production of high-value products and fuels. The perception of biorefinery is similar to the petroleum refineries in which an array of bioproducts is derived from biomass feedstocks. Thereby, biorefinery is the integration of several components such as itinerary of bioconversion, bioprocess design, and equipment development for the sustainable processing of biomass into a spectrum of marketable value-added products like biomaterials, biochemicals, and bioenergy. Bioprocessing and biorefinery have gained a successful routine for the bioremediation. In order to enhance the proper utilization and recovery of value-added products from biowaste and organic waste products, there is a need for detailed and broad-spectrum technical knowledge. This book “Bioprocess Engineering for Bioremediation: Valorization and Management Techniques” conceived keeping view of the social importance to deliver the available up-to-date technical

information to the researchers and engineers working on bioremediation and pollution control. The content of the book is the net outcome of eminent researchers and academicians in the field of biotechnology and chemical engineering. Today, more focus is given to green techniques and technology to overcome the limitations of conventional methods and reduce the global level pollution.

This book contains 14 chapters related to bioprocess and biochemical engineering and its application in bioremediation. More focus is given to address the solid and liquid waste management. This book highlights the importance of waste valorization in a sustainable and eco-friendly approach. The readers would be able to gather more information on biomass valorization in a cost-effective method. Herein, in this book, algal biomass and its diversified value-added products such as biofuel, bioplastics, bioactive compounds, biosorbents, and nano biopolymer are reviewed in detail. Lignocellulosic biomass, a second-generation biofuel feedstock, is reviewed and explained to explore for the production of sustainable green fuels. Further, agricultural biomass valorization for organic acid production using microbial bioprocessing is reported in detail with recent advancements. Few other chapters related to biological wastewater treatment, bioleaching of e-waste, and phytoremediation of soil for metal and organic pollutant removal are added to give an outline about the green techniques in waste management. This book also gives information about the municipal solid waste supercritical water gasification technology. Hydrothermal liquefaction technology, considered as an emerging method in the conversion of biomass into fuels and fine chemicals and seen as green remediation, will also give a detailed knowledge on biomass valorization. In a nutshell, this book is an interdisciplinary work focused on green chemistry that will give essential information on R&D perspective to the readers working on sustainable bioremediation specialization. Moreover, this book is written by reputed authors from various technical institutions based on their expertise and research outcomes. So, we believe this book will be a driving force for the young budding engineers as well for the experts searching for the valorization and waste management techniques. Interestingly, this book will address the treatment of waste using advanced bioprocess techniques. Therefore, the readers would be happy to find the alternative approach to the conventional chemical methods in an eco-friendly route. It is assured that this book will be a handbook for students, researchers, academicians, and engineers who are involved in various scientific areas related to waste management. Today, waste management is a challengeable task for the public as well as for the private sectors. We ensure our book would provide an affordable and innovative method of bioremediation for the present scenario.

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