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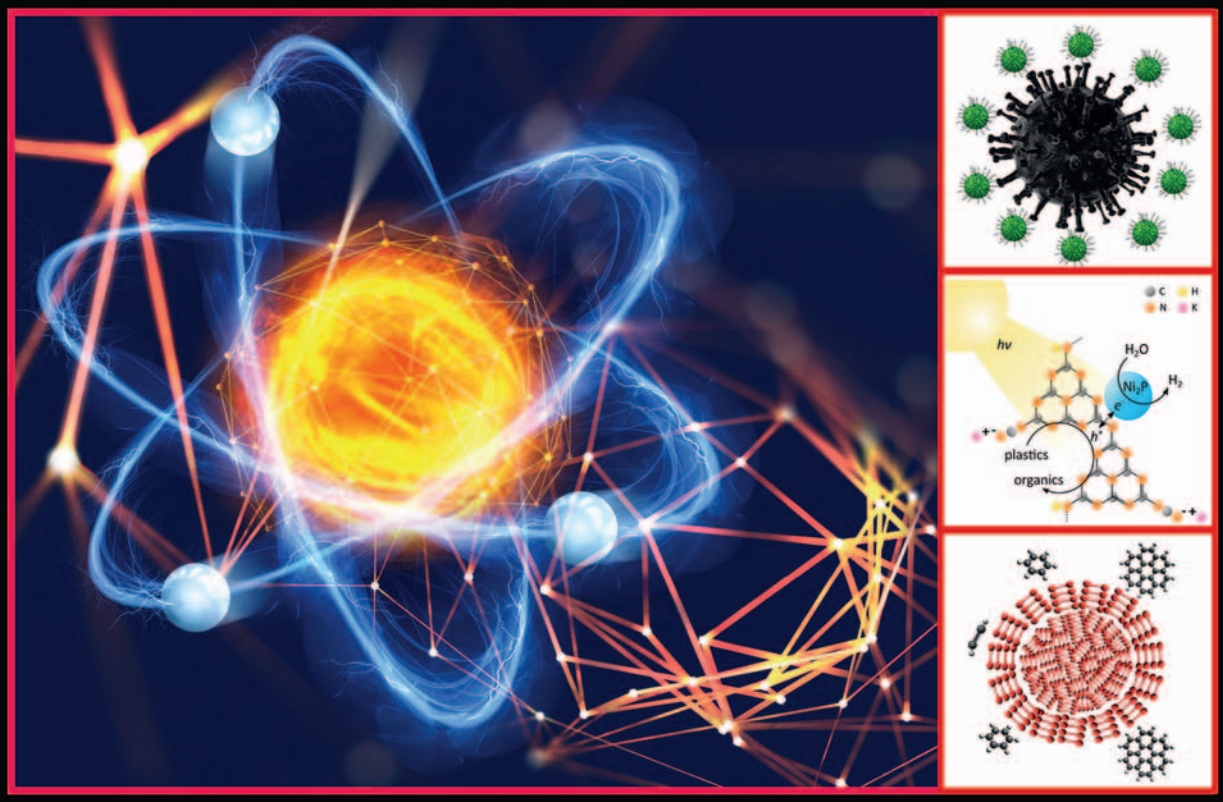
Environmental and Biomedical Applications



Edited by
Pranay Pradeep Morajkar
Milind Mohan Naik

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NANO AND BIOCHEMISTRY
ENVIRONMENTAL AND BIOMEDICAL APPLICATIONS

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PRANAY MORAJKAR

MILIND NAIK

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Dedication and acknowledgment

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Dr. Pranay P. Morajkar

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Preface

Environmental pollution is by far the greatest threat that the humanity faces today, which slowly but steadily is challenging the very existence of life on earth. The unregulated and untreated release of toxic and persistent pollutants such as Xenobiotics (dyes, pesticides, antibiotics, chlorinated biphenyl's), heavy metal pollutants (Pb, Zn, Hg, Ni, Cd, Cu, Cr, As), anionic pollutants (Fluorides and Nitrites), and polycyclic aromatic hydrocarbons, have been the major cause of water and soil pollution globally. The ever-increasing demand for energy through fossil fuel combustion has resulted in emissions of gaseous pollutants such as NO_x, SO_x, hydrocarbons, CO, CO_2, and solid-phase pollutant such as soot which not only diminishes air quality but also has a severe impact on global warming and climate change. The emergence of microplastics in water bodies and their detection in human blood has set shockwaves throughout the globe. It is due to the bioaccumulation of such persistent pollutants that the global and regional environments are threatened, which either directly or indirectly results in emergence of newer and newer classes of diseases. The ever-increasing antibiotic resistance of bacterial infections and the emergence of new classes of viruses such as SARS-CoV-2 resulted in the COVID-19 pandemic, which brought the entire world to its knees, enduring loss of countless lives.

It is therefore, we felt the need to highlight these issues in the environmental and biomedical field through this book, emphasizing on the use of nano and biochemistry together as a tool to address the above challenges. This book not only provides the fundamental knowledge on the above topics but also familiarizes the student and the research community about the recent developments in the emerging technologies for mitigation of environmental pollutants and their role in biomedical applications. Some of these nanotechnologies include designing of nanostructured materials with enhanced efficacies for adsorptive separation, photocatalytic degradation, bioremediation using nanozymes, Coupling of Photocatalytic and Bioremediation Processes (ICPB), biopolymers, bionanomaterials, and hydrogels for detection and mitigation of water pollutants. A special section is dedicated to the detection and quantification of atmospheric gaseous and solid-phase pollutants and their reduction and/or mitigation using novel biofuels, bio-nano additives, advanced engine strategies such as low temperature combustion, nanocatalyst-based catalytic converters, and diesel particulate filter technologies.

The application of nanotechnology in nanomedicines and targeted drug delivery systems has provided significant breakthroughs in treating and eradicating some of the most complex diseases discussed above and hence have become the prime focus of research in

biomedical sector. Nanoparticles have shown to inhibit biofilm formation in multidrug resistant bacteria through quorum quenching, an important feature of a pathogen in microbial colonization. Quantum dot-based nanostructures have showcased potential applications in bioimaging and diagnosis of viral infections. Biopolymers, metal organic frameworks, supramolecular organic nanostructures, and DNA-like nanostructured assemblies are proving to be emerging tools in biomolecular sensing, imaging, and in intelligent and targeted drug delivery systems. This book also highlights the toxicological aspects of nanomaterials by summarizing their toxicities as well as approaches to ameliorate the toxic side effects.

It is therefore we believe that this book will definitely help researchers, teachers, and students across disciplines especially those involved in disciplines of Chemistry, Physics, Environmental Chemistry, Chemical-Microbiology, Bio-Physical Chemistry, and Bio-Medical field. We hope that this book serves as a guiding platform to young and aspiring graduate/postgraduate students to pursue research careers in emerging and sustainable technologies for environmental and biomedical research.

Dr. Pranay P. Morajkar and Dr. Milind M. Naik