

Pathogenic Biofilm Eradication by Nanomaterials

Edited By
Ayush Madan, Sumel Ashique,
and Mohammad Ramzan

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Preface

Microbial biofilm has turned out to be a growing threat to public health, the environment, and industry. This structure is a highly resistant community of microbes covered with an extracellular polymeric substance. Microbial biofilms cause a significant portion of chronic infections, medical device malfunctions, and antibiotic-resistant bacteria. In response to this universal problem, a novel, interdisciplinary approach is required.

Recently, a novel weapon for controlling microbial biofilms has been developed through the application of nanotechnology. The extraordinary properties of nanomaterials, like the high surface-to-volume ratio, reactive surface, and the possibility of controlling reactivity, make this branch of science promise great potential in overcoming pathogenic biofilm. Various nanomaterials have been employed to deal with microbial biofilm.

In the edited volume titled *Pathogenic Biofilm Eradication by Nanomaterials*, an attempt has been made to compile key aspects of the most recent advancements, challenges, and future directions in the field under discussion. This book offers a compilation of various perspectives put forward by different experts in the subject matter who have focused on different perspectives of using nanomaterials for the eradication of biofilms.

It is important to note that special attention has been paid to emerging nanomaterials such as silver nanoparticles, carbon-based nanomaterials, magnetic nanomaterials, β -Cyclodextrin, and stimuli-responsive nanomaterials. Moreover, synergistic efforts combining nanotechnology with traditional antibiotics have also been explored.

It is our sincere pleasure to acknowledge the invaluable contribution of all authors who have prepared this compendium possible through their academic efforts. We are thankful to the reviewers for their insightful comments and suggestions that have greatly contributed to improving the quality of this work. Our thanks also go out to the editorial team for their professional assistance in the publication of this book.

We believe that this book will prove to be an asset to researchers, academicians, healthcare practitioners, and students involved in the domains of biotechnology, nanotechnology, microbiology, and biomedical science. It is our earnest hope that this book will motivate more scientific research into the problem of biofilm elimination.

Editors
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Pathogenic Biofilm Eradication by Nanomaterials

Chapter 9

Magnetic Nanomaterials

Eradication of Pathogenic Biofilms Associated with Infections

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Summary

Pathogenic biofilms pose significant challenges in infection management due to their resilience against conventional antimicrobial treatments. Magnetic nanomaterials (MNMs) have emerged as a promising solution for biofilm eradication, offering unique magnetic properties that facilitate targeted disruption. This chapter provides an overview of biofilms and their resistance mechanisms, followed by a discussion on the synthesis, characterization, and composition of MNMs. The mechanisms by which MNMs disrupt biofilms—including direct physical interactions, indirect antimicrobial effects, and synergistic strategies—are explored. Key applications in medical device-related infections, wound healing, and tissue infections are highlighted, with a focus on *in vitro* and *in vivo* studies. Additionally, the chapter examines the safety, toxicity, and regulatory considerations of MNMs, addressing biocompatibility concerns and potential environmental impacts. Finally, emerging trends and future directions are discussed to underscore the translational potential of MNMs in clinical settings. By integrating advanced nanotechnology with antimicrobial strategies, MNMs offer a novel and effective approach to combating biofilm-associated infections.