

Preface

Bacterial contamination is still an unresolved problem present in cases in which a biomaterial is required. This is an issue independent of the biomaterial considered and is particularly serious in those cases in which long-term implants are employed. In this context, polymers have been proposed as interesting candidates to improve the biomaterial performance in order to prevent microbial contamination. Different previous books have been published focusing their efforts on one of the aspects of antimicrobial polymers: the synthesis, in the biology of the microorganisms in contact with synthetic materials or related to their final use (e.g., food packaging). This book aims to present a complete overview of this rapidly evolving field providing a concise, clear, and precise image of the most important aspects involved in the use of polymers to combat microorganisms.

As will be depicted throughout this book, polymers' mode of action relies on physiochemical parameters such as hydrophobicity and cationic charge, rather than specific receptor-mediated interactions, so the activity of the polymers can be modulated by tuning key structural parameters. Taking into account the mechanism of action, polymers exhibit important advantages that have motivated their investigation as antibacterial materials. These include that polymers do not provide toxicity to the environment, do not develop resistance, and have an enhanced antimicrobial action. Other important advantages are their versatility; polymers are easy to process and cheap.

I hope that this text will be helpful for readers with very different backgrounds, ranging from chemists, biochemists, materials scientists, and engineers, who aim to have a general and complete overview of the use of polymers in the preparation of antimicrobial materials. This book is not presented as a manual and will not provide answers to all possible questions about polymers with antimicrobial properties. On the contrary, this book is intended to provide an introductory view highlighting important aspects including synthesis, surface functionalization and structuration, and the extension of these important aspects to the preparation of antimicrobial fibers, hydrogels, or membranes among others.

This text, devoted to the recent developments and ongoing works concerning the use of polymers as antifouling and antimicrobials for different applications, is organized as follows. The first part of this book (Chaps. 2 and 3) describes the basics of bacterial infections and the main functional groups incorporated into polymeric structures to avoid microorganism contamination. Chapter 4 depicts the use of nanostructured polymer assemblies in solution as antimicrobials.

The design and fabrication of polymer surfaces is analyzed in Chaps. 5 and 6. Chapter 5 discusses the alternatives to modify the surface chemical composition in order to introduce both antifouling and/or antimicrobial functional groups. Chapter 6 concerns those approaches that resort to both the modification of the surface topography and those that combine surface functionalization and patterning to remove bacterial contamination and biofilm formation.

Chapters 7, 8, and 9 are devoted to the use of antimicrobial polymers for the elaboration of three different materials. The approaches developed for the fabrication of nano- and microstructured fibers are depicted in Chap. 7. In Chapter 8, the synthesis and modification of hydrogels to improve the bacterial adhesion and to introduce antimicrobial moieties are described. Finally, Chap. 9 focuses on the elaboration of membranes with enhanced antifouling properties.

The last part of this book will analyze the eventual environmental concerns as well as safety issues related to the use of nanoparticles. The last chapter will summarize the future trends on the development of more sophisticated and effective antimicrobial polymer systems.

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Polymers against Microorganisms

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