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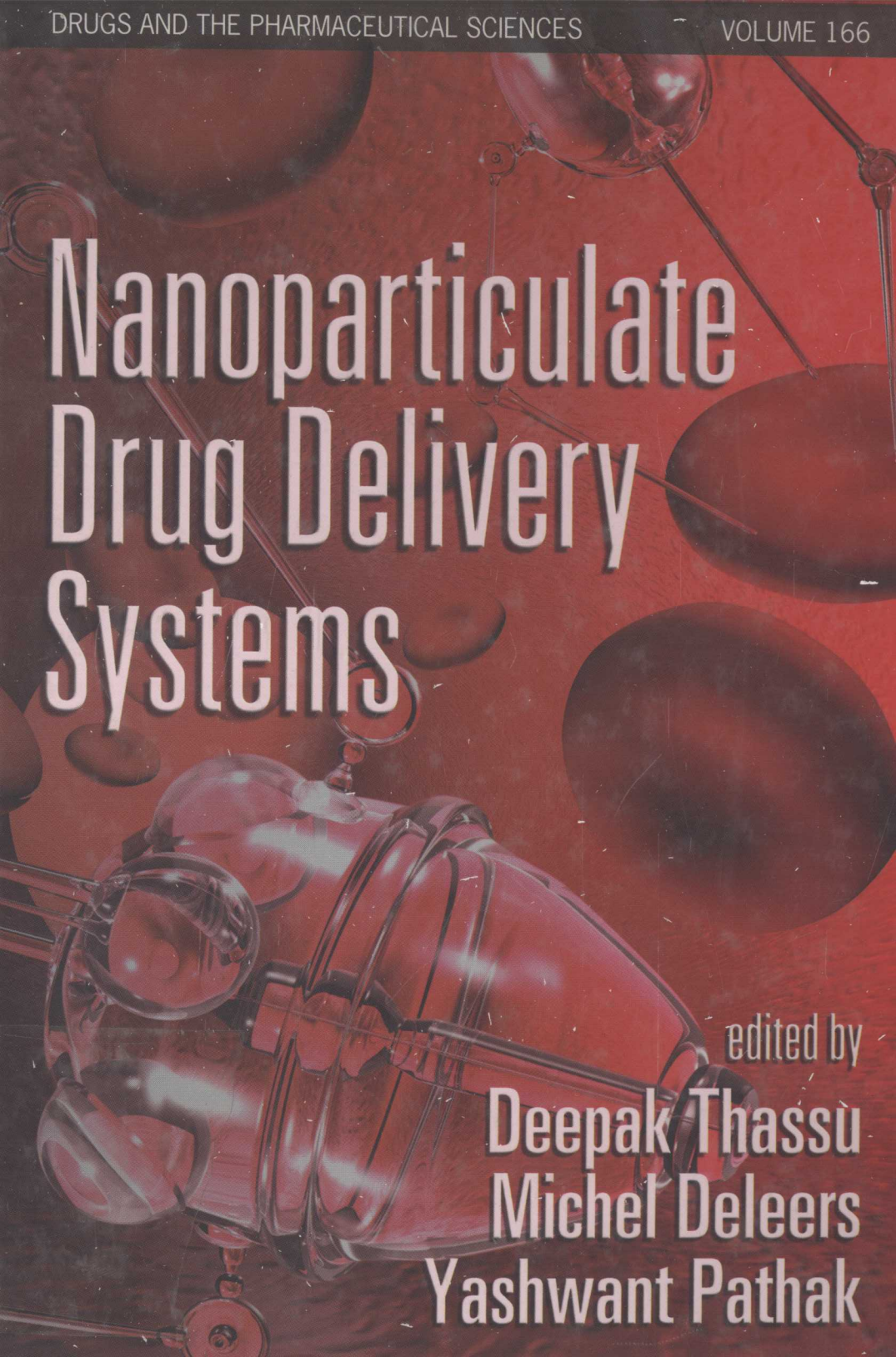
Nanoparticulate Drug Delivery Systems



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Nanoparticulate Drug Delivery Systems

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Foreword

The use of molecular or macromolecular entities and superstructures derived thereof for the delivery of drugs has a long history. Antibodies, for instance, were suggested early last century as a means to direct anticancer drugs to tumor cells in the body expressing the corresponding antigen. Their use in the form of monoclonals is now at the forefront of targeted therapy. Following advances in the discovery of cell receptors, receptor-binding macromolecules were added to the armamentarium of systems for the targeting of drugs. Parallel to these developments has been, since the early 1970s, the exploitation of liposomes as a delivery system for drugs and vaccines. These superstructures, formed spontaneously from amphipathic lipid molecules, together with a diverse collection of other promising superstructures derived from a huge variety of natural and synthetic monomeric or polymeric units, have evolved to sophisticated versions through the incorporation onto their surface of macromolecules that contribute to optimal pharmacokinetics of actives and their delivery to where they are needed. An ever increasing number of drug- and vaccine-delivery systems are being tested clinically, with many already marketed.

Recently, drug-delivery systems have been rediscovered as the biological dimension of nanotechnology. A leading article in a prestigious scientific journal tells us that "biologists are embracing nanotechnology—the engineering and manipulation of entities in the 1 to 100 nm range—and are exploiting its potential to develop new therapeutics and diagnostics." What else is new?, you might say! Nonetheless, the prefix *nano* (from the Greek word for *dwarf*) is a useful one because it helps define drug-delivery systems of a certain size range. Reflecting this trend of size definition, *Nanoparticulate Drug Delivery Systems* is a worthy attempt to bring together a wide range of drug-delivery systems for the delivery (targeted or otherwise), through a variety of routes of administration, of drugs, diagnostics, and vaccines in the treatment or prevention of disease, now encapsulated in the term "nanomedicine." Importantly, the book includes a wealth of the latest advances in the technology of nanoparticulates, including electrospinning, formation of microcrystals, production of liquid crystalline phases, and, last but not least, the technology of metallic nanoparticles. The editors, Deepak Thassu, Michel Deleers, and Yashwant Pathak, are to be complimented for both their judicial selection of nanosystems and choice of the international panel of contributors.

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Preface

For many decades, the interest in modifying drug-delivery systems has been a prominent thrust of pharmaceutical research. In recent years, due to tremendous expansion in the different scientific domains and skill sets, the scope has been widened to incorporate many faculties in the drug-delivery research covering physics, polymer sciences, electrical engineering, bioelectronics, genetics, biotechnology, and molecular pharmaceutics.

Pharmaceutical industry research culture is facing an uncertain future. Higher clinical development cost coupled with declining drug-discovery process and lower clinical success rates is decreasing the flow of new chemical entities in the research and development pipeline.

Due to the advent of analytical techniques and capabilities to measure the particle sizes in nanometer ranges, particulate drug-delivery systems research and development has been moving from the micro- to the nanosize scale. Significant research interests are geared towards utilizing the techniques where the particles can be reduced almost to nanometer ranges, thus reducing the dose and reactive nature of the molecule. This can deliver the drug at the targeted sites.

The book presented herewith is an attempt to describe the research efforts being done in this direction by the global scientific community. Nanoparticulate drug-delivery systems are a challenging area, and there are pulsating changes happening almost every day. This is an attempt to cover the recent trends and emerging technologies in the area of nanoparticulate drug-delivery systems.

The first chapter covers a complete overview of the nanoparticulate drug-delivery system, covering wide applications and evaluation of the nanoparticulate drug-delivery system in various fields. Chapter 2 encompasses formulations of nanosuspensions for parenteral delivery. The third chapter covers the polymer-based nanoparticulate drug-delivery systems. Chapters 4 to 6 focus on nanofibers, nanocrystals, and lipid-based nanoparticulate drug-delivery systems, respectively.

Chapters 7 to 10 discuss the engineering aspects and different techniques used for nanoparticulate drug-delivery systems, including nanoengineering, aerosol flow reactor, supercooled smectic nanoparticles, and metallic nanoparticles, respectively. Chapters 11 and 12 focus on biological requirements and the role of nanobiotechnology in the development of nanomedicines. Chapters 13 to 21 extensively cover the applications of nanoparticulate drug-delivery systems, including lipid nanoparticles for dermal applications; gene carriers for restenosis; ocular, central nervous system, gastrointestinal applications; adjuvant for vaccine development; and transdermal systems.

It is our hope that this multiauthored book on nanoparticulate drug-delivery systems will assist and enrich the readers in understanding the diverse types of nanoparticulate drug-delivery systems available or under development, as well as highlight their applications in the future development of nanomedicines. This book is equally relevant to academic, industrial, as well as scientists working in pharmaceutical drug delivery worldwide. The text is planned in such a way that each

chapter represents an independent area of research and can be easily followed without referring to other chapters.

We would like to express our sincere thanks to Tony Benfonte for the figures in Chapters 1 and 13 and to Linda Glather for reading the manuscript and suggesting corrections and punctuation. Special thanks to our editors, Stevan Zolo, Yvonne Honigsberg, and Sherri Niziolek, who helped us to get through the project successfully.

Last, but not least, we would like to express our sincere gratitude to all the authors who have taken time from their busy schedules to be part of this project and written wonderful chapters that added both the depth and value to this book.

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