

Biointeractions of Nanomaterials

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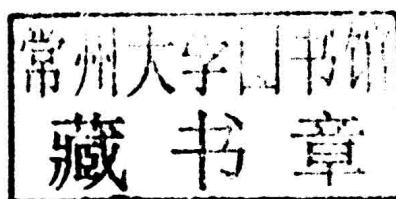
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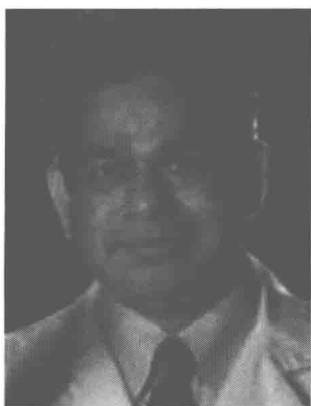
Dedicated to the loving memory of my father, Bhadabhai Chakubhai Sutariya, who passed away on April 22, 2013. He was my role model and mentor throughout my life and whatever I have achieved in life is because of his blessings. I would also like to dedicate this book to the memory of Swami Vivekananda; the world celebrated the 150th birthday of Swamijee in 2013.

Vijaykumar B. Sutariya

To the loving memories of my parents and Dr. Keshav Baliram Hedgewar, who showed the right direction; my wife Seema, who gave my life positive meaning; and my son Sarvadaman who gave a golden lining to my life.

Yashwant Pathak

Foreword



Nanomaterials are those in the nanometer range (10^{-9} m). These incredibly small particles can be organic or inorganic, with examples ranging from poly(lactic-co-glycolic acid) or gold nanoparticles to carbon nanotubes and quantum dots. These particles may be used to encapsulate drugs, recognize biological markers, or visualize body tissues among many other possibilities, all enabling their widespread application in biology, medicine, and pharmaceuticals. Indeed, these nanomaterials may have beneficial effects that have not even been imagined.

The small size of these particles provides an enormous surface area, which is ideal for interactions with cells on a molecular level, but also raises the question of their biosafety. The chemical composition of the diverse nanomaterials available for biological interactions may have unforeseen consequences in living systems. Whether the good that these interactions accomplish outweighs the risk of harm will have to be addressed before nanomaterials are used on a wide scale, especially in biological systems.

This book is a collaborative effort of the editors Drs. Vijaykumar B. Sutariya and Yashwant Pathak and the numerous contributors who are leading scientists in this field. The subject matter is of prime importance in the area of nanotechnology and its applications. These contributors, knowledgeable and experienced in their field, attempt to elucidate the potential biointeractions of nanomaterials with their respective applications in efforts to answer the questions posed above. This book presents the possible biointeractions of various nanomaterials with a number of different body tissues in a multitude of applications. I would like to congratulate Drs. Vijaykumar B. Sutariya and Yashwant Pathak at the University of South Florida for editing this important and timely book.

It is my great pleasure to write a foreword and present to you *Biointeractions of Nanomaterials*. I sincerely hope you will gain as much insight as I did from these chapters.

Shyam S. Mohapatra, PhD, MBA, FAAAAI, FNAI

Distinguished USF Health Professor and Director

Division of Translational Medicine-USF Nanomedicine Research Center

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President, USF Chapter of the National Academy of Inventors

Preface

The purpose of this book is to focus on the biointeractions of nanomaterials, an area that has not been previously addressed in detail. It also covers various techniques and tests that have been developed to evaluate the toxicity of materials at the nanolevel. The interactions of nanomaterials and nanosystems within biosystems are a concern for the scientific community.

This book is targeted toward academic researchers as well as industry members who are involved in the development of nanosystems. Many graduate schools have initiated courses in nanotechnology and applications, and this book will be a great resource for students as well as professors. Additionally, this will be a useful tool for industrial scientists investigating technology to update their nanotoxicology and nanosafety understanding.

The objective of the book is to address issues related to the toxicity and safety of nanomaterials and nanosystems. It also covers the interactions of these in biological systems, and various tools and methods used to evaluate toxicity and safety issues.

The volume comprises 20 chapters written by leading scientists in the field of nanotechnology. Chapter 1 covers the challenges and solutions of biointeractions of nanomaterials. This is followed by three chapters that address the assessment and characterization of nanosystems in the bioenvironment.

The next group of chapters covers toxicity and includes biosensing devices for toxicity assessment, carbon nanotubes, and pulmonary toxicity, as well as nanotoxicity of solid lipid nanoparticles. The final group of chapters from 8 to 20 covers nanosafety concerns and solutions. Each of these chapters delves into the effects of nanoparticles on different organs and sheds light on regulatory implications of nanomaterials.

We sincerely hope this book gets an overwhelming response from the scientific community in the field of nanotechnology.

We thank and acknowledge our families, the publishers, and our contributing authors. We would also like to acknowledge Aditya Grover, Anastasia Groshev, and Anjali Hirani for their assistance in editing and obtaining copyright clearance as well as the staff of Taylor & Francis who assisted in shaping this wonderful book in the field of nanotechnology.

Vijaykumar B. Sutariya
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Editors

Dr. Vijaykumar B. Sutariya earned his bachelor of pharmacy and master of pharmacy from L. M. College of Pharmacy, Gujarat University, Ahmedabad, India and his PhD in pharmacy from The M.S. University of Baroda, Vadodara, India. He did his postdoctoral training in the field of pharmaceutics and drug delivery at Butler University, Indianapolis, Indiana.

Dr. Sutariya is an assistant professor in the Department of Pharmaceutical Sciences at the University of South Florida (USF) College of Pharmacy. He has a joint appointment with the Department of Internal Medicine, Division of Translational Medicine at USF.

Dr. Sutariya has published more than 30 research papers in peer-reviewed journals and has presented at various national and international meetings. He is a reviewer of many international journals and an editorial board member of more than six journals related to drug delivery and pharmaceutical sciences. Dr. Sutariya's research is focused on the development of novel drug delivery systems such as nanoparticles, liposome, and thermoreversible gel. His main research focus is on brain-targeted drug delivery and ocular drug delivery. Dr. Sutariya is currently serving as a coinvestigator on two NIH grants (R01 and R15). In addition to research, Dr. Sutariya teaches various courses related to pharmaceutics in the Doctor of Pharmacy curriculum.

Dr. Yashwant Pathak completed his MS and PhD in pharmaceutical technology at Nagpur University, India and his EMBA and MS in conflict management from Sullivan University, Kentucky. He is an associate dean for faculty affairs at the College of Pharmacy, University of South Florida, Tampa, Florida. With extensive experience in academia as well as industry, he has to his credit more than 100 publications, 5 books on nanotechnology, 4 books on nutraceuticals, and several books on cultural studies, including 2 on aging studies from an Indian perspective. His areas of research include drug delivery systems and their characterization in animal models.

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