



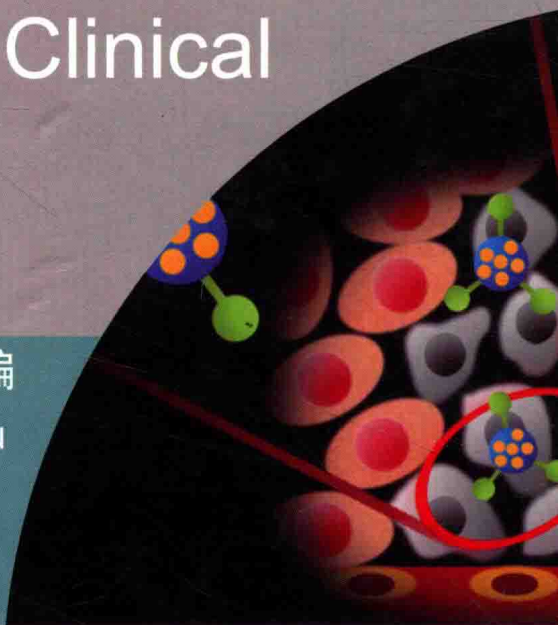
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Nanomaterials for Tumor Targeting Theranostics: A Proactive Clinical Perspective

谭明乾 吴爱国 主编
Mingqian Tan, Aiguo Wu
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高等教育出版社

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Foreword 1

This excellent reference text comes at a time when the research on theranostics is reaching a larger and larger audience. Theranostics is a contraction of therapy and diagnostic, meaning that the action of a drug on a patient can be followed in real time. Theranostics is presently a cutting-edge topic in biomedicine and requires both extended knowledge in genomics, proteomics, metabolomics, and suitable advanced techniques in bioanalysis and bioimaging. It is expected that its developments will lead to personalized medicine within the next decade, especially in the field of cancer therapy and early detection. There are several ways of taking advantage of this new array of medical technologies. One is to identify the patients for whom a given drug is not working; another one is to apply diagnosis and therapy in sequence for distinguishing variants of diseases in order to apply the best suited therapy to a given patient; the later one is the so-called co-development in which two drugs are applied leading to a synergistic effect.

It is now well recognized that nanotechnology permits a combination of functionalities within a single particle and therefore is ideal for taking diagnosis from the medical laboratories to the point-of-care by making use of lab-on-a-chip devices. In this respect, a whole range of nanomaterials are at hand, facilitating the work of biochemists and medical doctors.

This book precisely informs chemists, biochemists, biologists, and medical doctors of the strengths and applications of nanomaterials in this fast developing field. The various chapters perfectly illustrate that scientists involved in the development of nanomaterials are finding better, faster and more cost-effective technologies. All aspects are covered, from magnetic nanomaterials, to quantum dots, mesoporous silica nanoparticles, surface enhanced Raman scattering nanomaterials, polymeric nanostructures, carbon nanomaterials, lipopolyplex nanoparticles and microbubbles. Upconversion nanomaterials, functional dendrimers, and protein-based nanoparticles are also included.

The editors are leading figures in the field and their competences have led to a well-balanced text with two introductory chapters, 11 topical reviews, and a perspective chapter to conclude the opus. I certainly recommend this book

for teaching at the master and doctorate levels and for any scientists involved in either nanoscience or theranostics and, of course in both.

Jean-Claude G. Bünzli FRSC
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Lausanne, September 24, 2013

Foreword 2

The integration of nanotechnology with medicine has led to a significant advancement in the medical sciences. Nanomaterials can be used for both diagnostic and therapeutic purposes at the same time, which can't be achieved by small molecules or other microscale tools. Nanotechnology has given rise to a new theranostic tool. It provides the promising agents that propel the biomedical practice towards personalized medicine, and paves a way towards the development of innovative strategies in the cancer treatment.

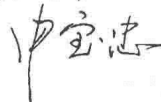
This book is an excellent introduction of the nanomaterials based platforms for tumors theranostics. It will explicate the mechanism and application of this platform in targeting diagnostic imaging, such as magnetic resonance, optical, positron emission tomography and surface enhanced Raman scattering; and in therapeutics including hyperthermia, photodynamics and photothermal therapy, as well as gene and drug delivery. It covers all the major materials from magnetic nanomaterials, quantum dots, noble metals and carbon nanomaterials to polymeric nanoarchitectures, proteins, *etc.*

The editors of this book are young elites in the field, who have carried out extensive research projects and accomplished many remarkable achievements in the nanomaterials based tumor targeting theranostics. They devoted a great deal of precious time and effort to present useful information in this book. I am delighted to see that besides them, there are lots of young scholars in China and around the world who dedicate themselves to the research of targeting, imaging, and therapeutics at the cellular and molecular level. They are becoming the drive force of biomedical science development in recent years.

This is a timely book for introduction of nano-based theranostics. I, therefore, strongly recommend this book to all of the students and scholars in academe or industry who are interested in this rapidly expanding field. It is

also helpful for the clinicians to acquire cutting-edge knowledge and to get a better understanding of nanomaterials and tumor targeting theranostics.

Shen, Baozhong M.D., Ph.D.

A handwritten signature in black ink, consisting of stylized Chinese characters, likely '申宝忠' (Shen Baozhong).

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Harbin, December 12, 2013

Preface

At the beginning of the twenty-first century, cancer is still a major leading cause of death worldwide because of the unpredictable and numerous challenges for early diagnosis and effective treatment. The remarkable advance about “nanoworld” during the past two decades has encouraged hopes of nanotechnology to be a game changer for the diagnosis and treatment of cancer. However, most efforts to improve the cancer treatment through nanotechnology are still in its infancy and there has been no routine nanomedicine for tumor theranostics in clinical practice. Indeed, the use of nanomaterials in cancer diagnosis and treatment offers great potential for effective detection and inhibition of tumor growth at the early stage, as well as destroying cancer tumors with minimal damage to healthy tissue and organs. On the basis of this, the idea for writing a book to summarize the nanomaterials for tumor targeting theranostics came to us. We hope that the book may be helpful for the readers to get a more realistic understanding of both the advantages and limitations of nanomaterials for potential tumor targeting theranostics.

Theranostics is a term coined to describe a strategy that combines diagnostic and therapeutic modalities into one platform to develop all-in-one therapeutic agents. For the cancer treatment, theranostics agents may offer the possibility to monitor and treat the tumor according to the disease progresses in one dosage. Multiple diagnostic and therapeutic techniques are integrated into a functional platform to provide tumor patients with selectable treatments for improved prognoses. Examples of designing and evaluating various types of nanomaterials for tumor targeting theranostics are found throughout the book, and we hope thereby to give a profile to the entire development. The book is organized as follows: Chapter 1 introduces the concept of theranostics for tumor therapy based on the major nanomaterials discussed throughout the rest of the text. Chapter 2 discusses the basic ideas of tumor theranostics. Chapter 3 covers the advances of magnetic nanomaterials in cancer theranostics with an emphasis on magnetic resonance imaging, hyperthermia, photodynamic therapy, photothermal therapy and drug/gene delivery. Chapter 4 surveys the synthesis, surface functionalization, properties, and biomedical applications of different types

of semiconductor quantum dots (QDs) for tumor imaging, and targeted drug delivery and cancer therapy, both *in vitro* and *in vivo*. Chapter 5 highlights the progression of mesoporous silica nanoparticles with diverse functional structure and control morphology for tumor theranostics. Chapter 6 moves up to surface enhanced Raman scattering technique based on silver/gold nanoparticles for tumor theranostics. Chapter 7 describes the critical issues confronted in the design, synthesis, and characterization of polymeric nanosystem and their applications in theranostics. Chapter 8 introduces carbon nanomaterials including carbon nanotubes, graphene, carbon dots, fullerene and nanodiamonds, used for tumor targeting theranostics for improving tumor imaging, earlier detection and specific drug delivery. Chapter 9 discusses the development of cationic nonviral lipopolyplex for targeted gene delivery combined with diagnosis and therapy. Chapter 10 considers the possibility of nano/microbubbles for imaging and therapeutic purpose in tumor theranostics. Chapter 11 discusses the mechanism of upconversion fluorescence and bio-applications of upconversion nanomaterials in bioimaging, tumor photodynamic therapy and drug/gene delivery. Chapter 12 introduces the functional dendrimers as theranostic vehicles for the cancer treatment. Chapter 13 describes the nontoxic, non-immunogenic, biocompatible and biodegradable protein-based nanoparticles for tumor targeting theranostics. Chapter 14 makes a summary of this book and gives a perspective of nanomaterials for targeting theranostics.

We hope that the publication of this book will accelerate the spread of ideas that are currently trickling through the scientific literature. Also a greater understanding of the potential and challenge of nanomaterials for tumor targeting theranostics is highly expected for the practical clinical use. We thank all the authors and reviewers who made valuable contributions to this book for helpful discussions, comments, and corrections during the writing and revision process.

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