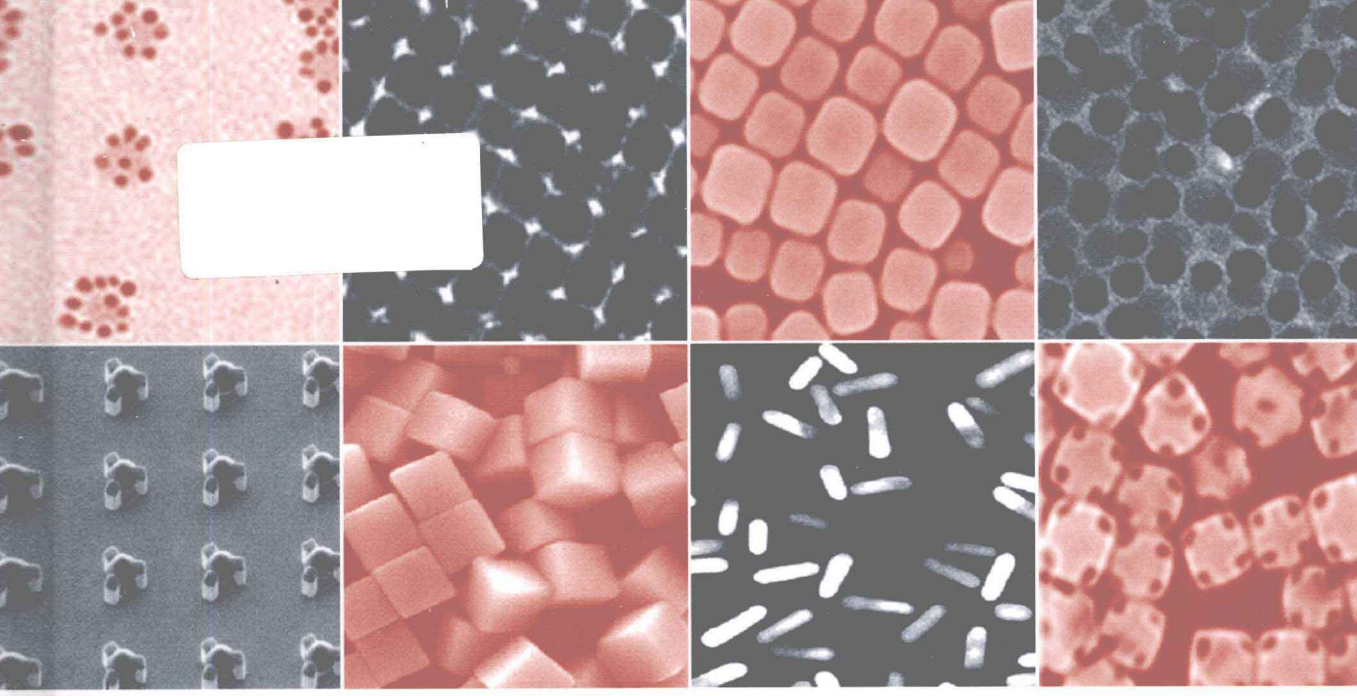

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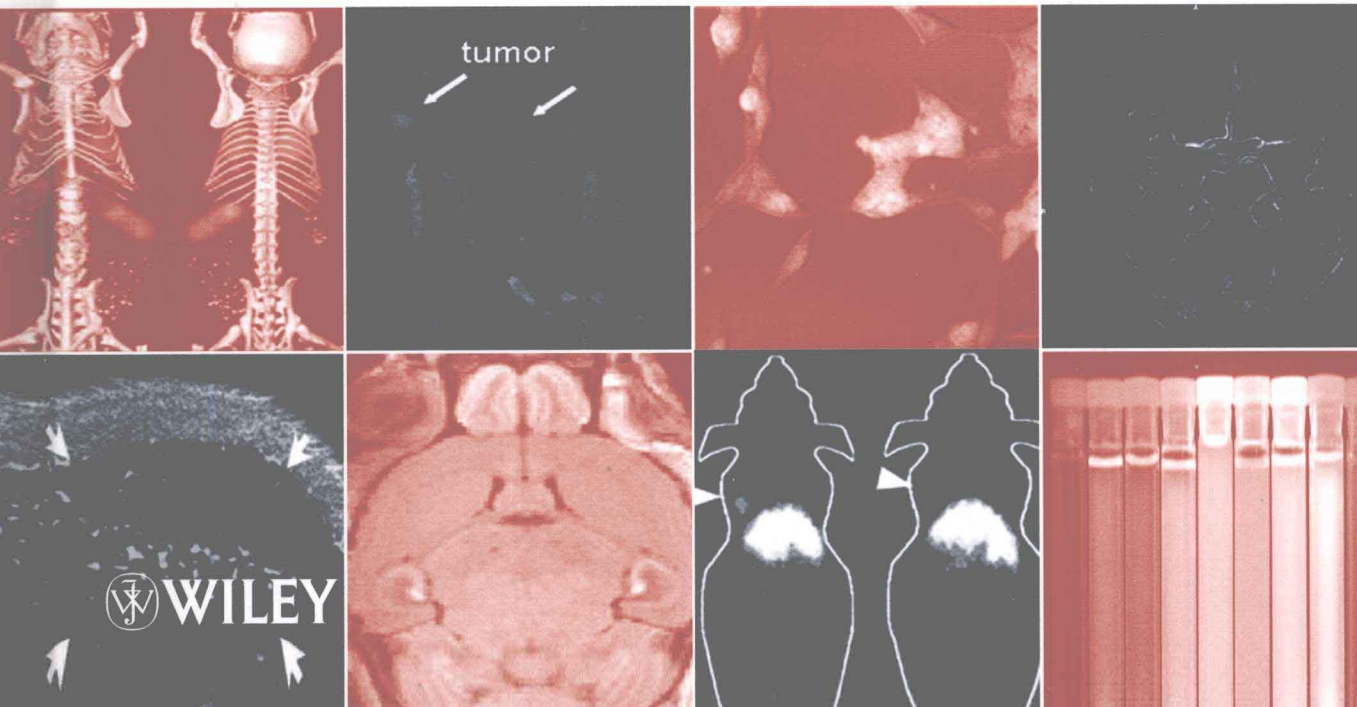

NANOPLATFORM-BASED MOLECULAR IMAGING

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WILEY
A JOHN WILEY & SONS, INC., PUBLICATION

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.
Published simultaneously in Canada.

Library of Congress Cataloging-in-Publication Data:

Nanoplatform-based molecular imaging / edited by Xiaoyuan Chen.
p. ; cm.
Includes bibliographical references and index.
ISBN 978-0-470-52115-1
1. Molecular probes. 2. Diagnostic imaging. I. Chen, Xiaoyuan.
[DNLM: 1. Molecular Imaging–methods. 2. Molecular Imaging–trends. 3. Molecular Probes–diagnostic use. 4. Nanoparticles–diagnostic use. 5. Nanotechnology–trends. WN 180 N1865 2010]
QP519.9.M64N36 2010
616.07′54–dc22

2010007984

Printed in Singapore

eBook ISBN: 978-0-470-76703-0
oBook ISBN: 978-0-470-76704-7

10 9 8 7 6 5 4 3 2 1

PREFACE

This book focuses on the rational design of water-soluble, biocompatible nanoparticles for the visualization of the cellular function and follow-up of the molecular processes in living organisms without perturbing them. Molecular imaging probes based on nanotechnology hold great potential in diagnosis, imaging guided intervention, and treatment response monitoring of diseases. This book is logically organized by including the basics of molecular imaging, general strategies of particle synthesis and surface chemistry, applications in computed tomography (CT), optical imaging, magnetic resonance imaging (MRI), ultrasound, multimodality imaging, and theranostics, and finally clinical perspectives of nanoimaging. This comprehensive title provides expert opinions on the latest developments in molecular imaging using nanoparticles. This book consists of 32 chapters and was contributed by nearly 100 authors worldwide, who are among the world's prominent scientists in material science and/or molecular imaging.

Part I consists of Chapters 1–4 Chapter 1 describes the basic principles of molecular imaging, how nanoparticles can be applied to different molecular imaging modalities, and challenges in developing nanoparticle-based molecular imaging probes; Chapter 2 highlights the general strategies to produce narrowly dispersed nanomaterials for molecular imaging; Chapter 3 emphasizes the importance of surface modification to render nanoparticles biocompatible and suitable for molecular imaging applications; and Chapter 4 talks about the toxicity and factors such as size, shape, coating, and surface charge that affect the biodistribution and pharmacokinetics of nanoprobes.

Part II consists of Chapters 5–17 Chapter 5 illustrates the basic principles of CT, the evolution of CT imaging technology, and the rationale for nanoparticle-based CT contrast agents; Chapter 6 describes the advantages of fascinating carbon nanotube field emission X-ray technology over conventional thermionic X-ray tubes that are used in current X-ray imaging systems; Chapter 7 describes the use of unique optical properties of semiconductor quantum dots (QDs) for near-infrared fluorescence imaging in living animals; Chapter 8 introduces macromolecular nanoconstructs such as biopolymers, dendrimers, and liposomes as carriers for fluorophore conjugation and optical imaging; Chapter 9 summarizes recent progress in developing nanoplatforms for Raman imaging of biological systems; Chapter 10 summarizes the work in using single-walled carbon nanotubes (SWNTs) as near-infrared fluorescent sensors for biomolecule detection; Chapter 11 describes the use of micro- and nanoparticles as ultrasound contrast agents; Chapter 12 proposes the use of metal nanoparticles in ultrasound-based photoacoustic and magnetoacoustic imaging modalities; Chapter 13 reports the progress on magnetic resonance imaging (MRI) contrast agents based on inorganic nanoparticles; Chapter 14 emphasizes the use of iron oxide nanoparticles for cellular labeling followed by T_2- and T_2^*-weighted MRI; Chapter 15 covers the use of rare earth based nanoparticles for MR imaging as positive contrast agents; Chapter 16 reviews the top–down microfabrication technology to synthesize multispectral MRI contrast agents;

and Chapter 17 gives an overview of the strategies to label nanoparticles with radionuclides to study *in vivo* distribution.

Part III consists of Chapters 18–31 Chapter 18 introduces techniques to incorporate imaging agents into lipoproteins and to reroute lipoproteins to cancer specific epitopes; Chapter 19 exemplifies the use of protein cages such as virus capsids and ferritins as platforms for MRI contrast agents and fluorescent imaging agents; Chapter 20 provides a comprehensive summary of the state-of-the-art of SWNTs for multimodality biomedical imaging applications; Chapter 21 reviews the progress in the controlled synthesis, surface modification, and multimodality imaging applications of multifunctional nanoparticles in recent years; Chapter 22 argues the use of cancer theranostics as a promising new strategy in cancer management, permitting simultaneous cancer diagnosis, drug delivery, and real-time monitoring of therapeutic efficacy; Chapter 23 provides more examples of multifunctional nanoparticles for combined cancer imaging and therapy (theranostics); Chapter 24 describes the recent progress in modifying magnetic nanoparticles for multimodality imaging as well as targeted treatment of a number of diseases; Chapter 25 introduces gold nanocages as contrast agents for optical bioimaging (such as optical and spectroscopic coherence tomography amd photoacoustic tomography) and photothermal treatment; Chapter 26 describes the biological inertness, ease of manufacture and bioconjugation, and presumed lack of toxicity of gold nanoparticles for simultaneous sensing, imaging, and treatment of tumors; Chapter 27 presents the recent developments in the chemistry and photophysics of gold nanorods and their applications toward biological imaging and photothertmally activated therapies; Chapter 28 describes a number of gold core–shell nanostructures for cancer molecular optical imaging, controlled drug delivery, and photothermal ablation therapy; Chapter 29 describes a novel temperature and pH-responsive magnetic nanocarrier that combines tumor targeting and controlled drug release capabilities; Chapter 30 deals with perfluorocarbon nanoparticles as a multidimensional platform for targeted image-guided drug delivery; and Chapter 31 describes the use of radiolabeled nanoparticles and radiolabeled immunonanoparticles for imaging and therapy.

Part IV is the concluding Chapter 32 that highlights some of the nanoparticle-based novel technologies for molecular imaging, diagnosis, and drug delivery formulations. The limitations and future challenges of nanoparticle-based systems are also discussed.

Bethesda, Maryland XIAOYUAN CHEN

ACKNOWLEDGMENTS

The editor thanks the nearly 100 authors throughout the world for their contributions and collaboration on this book project. The editing work of this book was accomplished using a significant amount of the editor's spare time including family time. Therefore the editor also thanks his wife, Michelle Ji, and his daughter, Grace Chen, for their wonderful support and understanding.

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