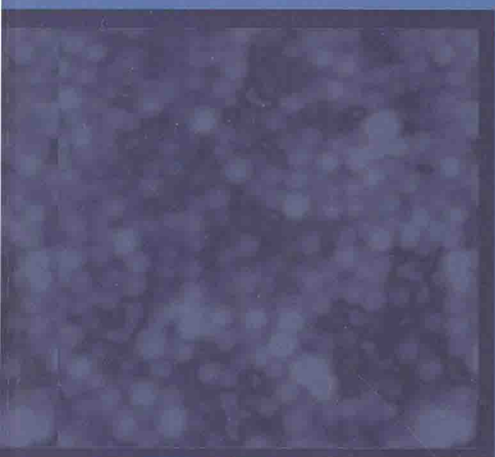
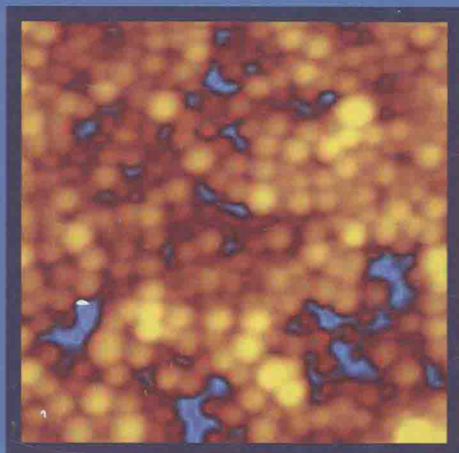
Horizons in Clinical Nanomedicine





edited by
Varvara Karagkiozaki
Stergios Logothetidis

Horizons in Clinical Nanomedicine

edited by

Varvara Karagkiozaki

Stergios Logothetidis

Pan Stanford Publishing

Published by

Pan Stanford Publishing Pte. Ltd.
Penthouse Level, Suntec Tower 3
8 Temasek Boulevard
Singapore 038988

Email: editorial@panstanford.com
Web: www.panstanford.com

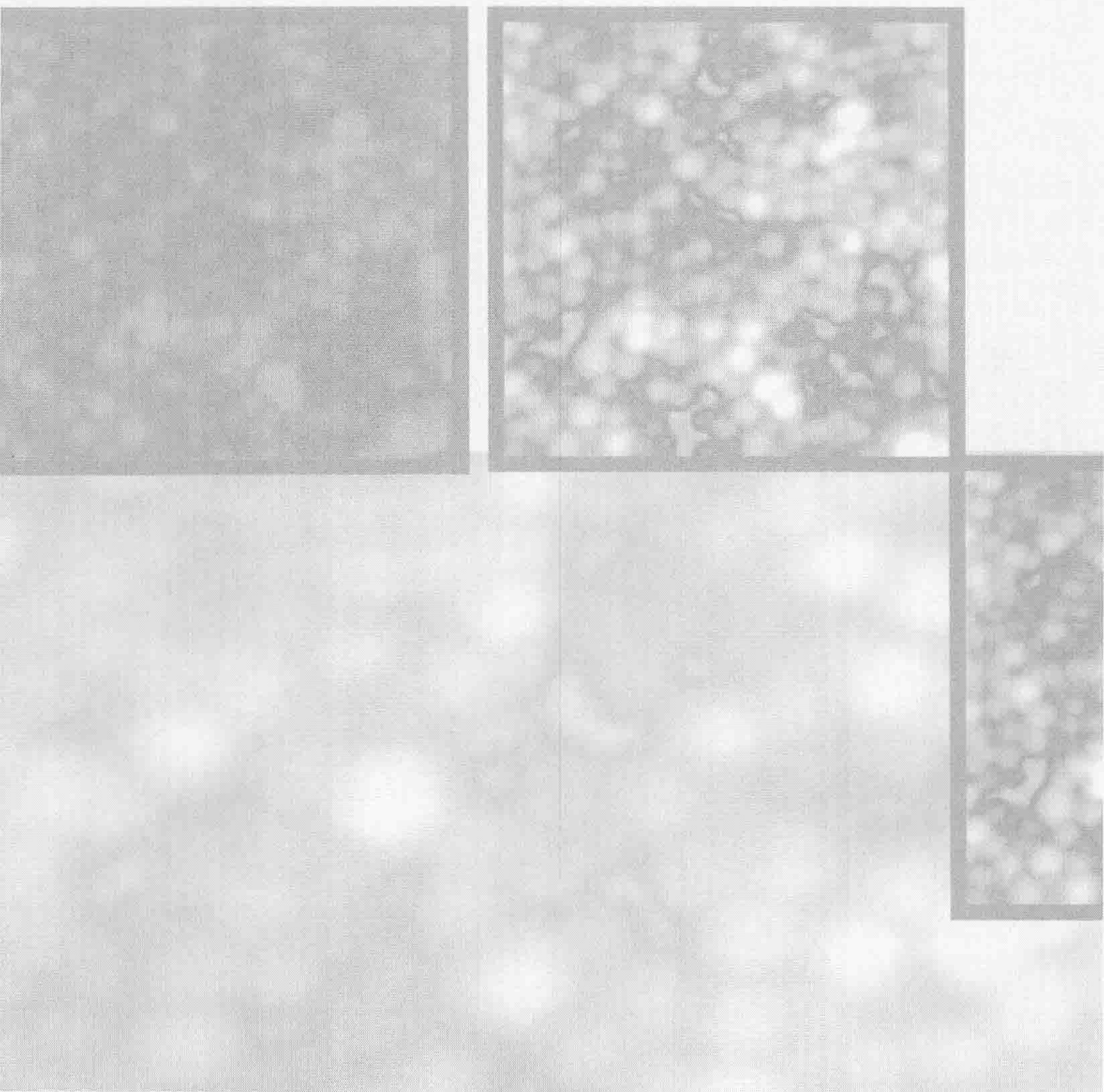
British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library.

Horizons in Clinical Nanomedicine

ISBN 978-981-4411-56-1 (Hardcover)
ISBN 978-981-4411-57-8 (eBook)

Printed in the USA

Horizons in Clinical Nanomedicine



Preface

Nanomedicine, a flourishing field of medical research, is expected to provide modern medicine with innovative solutions to the unmet and unsolved clinical needs. Nanostructured materials have the potential to revolutionize healthcare, due to their novel intrinsic physicochemical properties which can be exploited towards cutting-edge developments in the fields of diagnosing, treating, and preventing diseases, injuries, or genetic disorders. Thus, clinical nanomedicine holds great promise as a future powerful tool of medicine that improves human health.

This book presents a broad overview on nanomedicine tools, materials, and processes to be applied to different medical disciplines. It presents the broad spectrum of nanomedicines for the early, accurate diagnosis and effective treatment of human diseases. Taking into account the pillars of in vitro and in vivo nanodiagnostics, regenerative medicine, and nanopharmaceuticals, it deals with the unsolved medical problems in cardiovascular disease, AIDS, cancer, blood diseases, congenital defects, dermatology, dentistry, and orthopaedics, with a focus on personalized medicine. It addresses nanosafety and nanotoxicity issues to highlight the significance of nanomedicine applied into clinical practice for the benefit of the patient. The book will appeal to researchers, medical doctors, and graduate students who want to get in-depth knowledge of nanomedicine utilities for clinical applications.

Contents

Chapter 1

Introduction in Clinical Nanomedicine

Stergios Logothetidis
Lab for Thin Films—Nanosystems and Nanometrology,
Department of Physics, Aristotle University of Thessaloniki,
54124 Thessaloniki, Greece
logot@auth.gr

Nanotechnology represents the possibility of revolutionising many aspects of our lives. Nanomedicine, the application of nanotechnology to health, is one of the most promising fields of biomedical research, building up a novel research culture by encompassing the principles of traditional disciplinary boundaries (i.e., physics, chemistry, biology and engineering). Nanomedicine has the potential to give intelligent solutions to many of the current medical problems, by opening the door to a new generation of advanced drug delivery systems, improved diagnostic systems (in vitro and in vivo) and novel methods and materials for regenerative medicine. There are currently two families of therapeutic nanocarriers (i.e., liposomes and albumin nanoparticles) that have been approved and used in clinical settings, providing clinical benefit. Moreover, several nanocarriers are in clinical trials and even more are in pre-clinical

Horizons in Clinical Nanomedicine
Edited by Varvara Karagkiozaki and Stergios Logothetidis

ISBN 978-981-4411-56-1 (Hardcover), 978-981-4411-57-8 (eBook)
www.panstanford.com

phases. Despite the cutting-edge developments in nanomedicine, the process of converting basic research to viable products is expected to be long and ambitious. A crucial factor that should also be taken into consideration is the toxic effects of the novel therapeutical products in human health. Thus, a massive effort is required to translate laboratory innovation to the clinic and begin to change the landscape of medicine.

1.1 Introduction

Richard Feynman in 1959[1] was the first one to claim that 'there is plenty of room at the bottom', and since then, a booming interest in studying the nanoscale has emerged. The nano prefix comes from the Greek word 'Nano' meaning dwarf, with 1 nanometre (nm) being equal to one billionth of a metre (10^{-9} m), or 10 water molecules, or about the width of six carbon atoms. Atoms are smaller than 1 nm, whereas many molecules, including proteins, can range in size from 1 nm to several hundreds, as shown in Fig. 1.1.[2] Studying at such scales is of great importance, as the properties of matter differ significantly, especially due to quantum effects and the large surface-to-volume atom ratio. As a result, new findings arise, contributing to a better understanding of science.

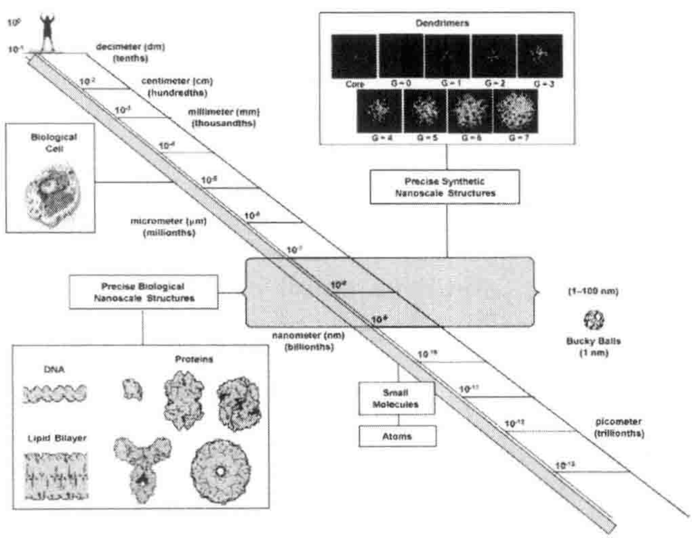


Figure 1.1 Nanoworld and Macroworld: the scale of natural objects.[3]