

Preface

While the recently published first volume of the *NtLS* series, *Biofunctionalization of Nanomaterials*, dealt with approaches to tailoring nanomaterials to be useful in biomedical applications, this second volume of the series, which I am pleased to present to you herewith, focuses on nanomaterials derived from biologically and pharmaceutically important substances. Twelve chapters describe in depth the various nanotechnological aspects behind using DNA, proteins, peptides, chitosan, lipoplexes, lipids and drugs. DNA is the most important and well studied biological molecule which itself is in the nano size regime. One of the attractive features of products containing DNA is the potential for producing materials of biological nature. Although DNA-based nanotechnology is currently in its infancy, it is likely to impact future applications in industrial segments such as electronics, sensors, medicine, and many other fields. The book has four chapters on DNA based nanomaterials. It begins with a chapter entitled *Self-Assembled DNA Nanotubes*, which is a contribution from the laboratories of Thom LaBean and Sung Ha Park from Duke University, USA, on self-assembled one-dimensional (1D) DNA nanotubes with unique design schemes and characteristics. In this chapter, approaches to assembly of artificially designed tiles, DX, TX, 4×4, and 6BH branched-junction tiles to form 1D DNA nanotubes have been described. The second chapter illuminates on the importance of development of effective nucleic acid nanocarriers and provides approaches to prepare DNA nanoparticles containing a single DNA molecule (the minimal particle size possible) as well as their characterization and properties. This chapter, *Nucleic Acid Nanoparticles*, presented by Guy Zuber and co-workers from the Genetic Chemistry Laboratory of Illkirch University, France, reviews strategies for synthesis of DNA nanoparticles and possibilities to functionalize them with cancer cell targeting elements. Mixing DNA with cationic lipids leads to spontaneous self assembly of ordered aggregates known as lipoplexes whose size can range from around 100 nm to several microns depending on preparation conditions. The third chapter, *Lipoplexes*, written by Sarah Weisman from Technion Israel Institute of Technology in Haifa, Israel, gives an overview of the current state of knowledge about lipoplexes, with special attention to their microscopic structure, and the relationships between structure and gene delivery efficiency. Julio C. Fernandes and co-workers from the Medical Faculty of Montreal University, Canada, brought out an exhaustive review on DNA-Chitosan polyplexes presented

in the fourth chapter, *DNA-chitosan Nanoparticles for Gene Therapy: Current Knowledge and Future Trends*. In addition to the basic concepts, the chapter provides information on different procedures to obtain nano- and micro DNA-chitosan particles and their clinical application as non-viral vectors in gene therapy.

Switching gears from DNA to proteins, the book provides a further four chapters on different facets of peptide and protein based nanomaterials. Proteins are a class of natural molecules that have unique functionalities and potential applications in both biological as well as material fields. Nanomaterials derived from proteins, especially protein nanoparticles, are biodegradable, metabolizable and can also be easily amenable for surface modification and covalent attachment of drugs and ligands. In the fifth chapter, Anne-Marie Orecchioni and co-workers from the Laboratory of Galenic Pharmacy of Rouen University, St. Etienne du Rouvray, France, provide an exhaustive account of plant based proteins, their synthesis and applications. This particular chapter, *Plant Protein-based Nanoparticles*, not only provides information on conventional plant protein nanoparticles but also describes 'decorated' (i.e., conjugated) storage protein nanoparticles. Continuing on a similar theme, Klaus Langer from the Biocenter of Frankfurt on Main University, Germany, provides a comprehensive account in chapter six, *Peptide Nanoparticles*, on preparation techniques for peptide and protein-based nanoparticles with focus on their application in drug delivery. Narrowing down from a broad perspective on protein nanoparticles described in chapters two and three, chapter seven has the title *Albumin Nanoparticles*, indicating a review on a specific protein, Serum Albumin, which is extremely important in physicochemical, immunochemical and drug delivery applications. In this chapter, Juan Manuel Irache and Socorro Espuelas from the Galenics Center of Navarra University in Pamplona, Spain, summarize preparation and main applications of albumin nanoparticles for pharmaceutical purposes. Chapter eight, *Nanoscale Patterning of S-Layer Proteins as a Natural Self-Assembly System*, by Margit Sára and co-workers from the Center for Nanobiotechnology of the Agricultural University of Vienna, Austria, provides a survey of the general principles of crystalline bacterial cell surface layer (S-layer) proteins and fusion proteins which are being exploited as building blocks and templates for generating functional nanostructures at the meso- and macroscopic scale for both life and non-life science applications.

Pharmaceutical research and development has recently moved into a new direction thanks to the possibility of obtaining nanoformulation of drugs, i.e. formulation of drugs using nanoparticles. Keeping in tune with this trend a separate chapter specifically on drug nanoparticles has been included in this volume. Chapter nine, *Preparation Methods of Drug Nanoparticles* by Jonghwi Lee and co-workers from the Department of Nano Materials Science at Sejong University in Seoul, Korea, describe methods of preparation of drug nanoparticles, their characterization and advantages over conventional methods. In addition, chapter ten provides a review on Solid-Lipid Nanoparticles delineating the concept of differential protein adsorption as the concept of functionalization of SLN via surface modification from a practical point of view. In this chapter entitled *Production of Biofunctionalized Solid Lipid Nanoparticles for Site-specific Drug Delivery*, Rainer H. Müller and

co-workers from the Department of Pharmaceutical Technology of Free University Berlin, Germany, review methods used for the functionalization of solid lipid nanoparticles by modification of their surface characteristics followed by examples for their application in site-specific drug delivery. Mostafa Sadoqi and co-workers from the Physics Department of St John's University at Jamaica, USA, discuss near-infrared dye (NIR) indocyanine green (ICG) loaded PLGA drug nanoparticles and their application in cancer diagnosis and therapy in chapter eleven, *Biocompatible Nanoparticulate Systems for Tumor Diagnosis and Therapy*. Finally, since membrane transport plays an important role in cellular and subcellular pathways, including multidrug resistance (MDR), cellular signaling and cell-cell communication, an exclusive chapter, placed in twelfth position, discusses general information on cell membranes and the problems encountered by drugs when trying to cross them, and why drug nanoparticles are preferred. This chapter, *Nanoparticles for Crossing Biological Membranes*, is presented by Rajendra P. Pawar, A. Avramoff and Abraham J. Domb from the Department of Medicinal Chemistry of the Hebrew University of Jerusalem, Israel.

I do hope that the information that has been painstakingly accumulated by several researchers in this second volume will help in furthering better understanding of the nanosystems derived from biological materials, leading to new and potent applications. I am very grateful to all the authors for their excellent presentation of their topics, providing timely inputs and corrections in making the second volume a reality. I am always thankful to my employers, family, friends and Wiley-VCH publishers for their continued support and encouragement. Finally, my special thanks to you, the readers, for making attempts to utilize the knowledge base provided in this book. I look forward to receiving your comments and suggestions.

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