

Preface

Advances in nanotechnology have allowed for potentially earlier identification and treatment of disease pathologies that are of cellular and molecular origin. These enable us to detect biological signatures even before the actual manifestation of a disease, leading to a medicine that is ‘pre-emptive’ in nature. This approach is a paradigm shift from conventional medicine, which is more ‘symptomatic’ in character. At the nanoscale, unique properties emerge enabling us to deliver higher local concentrations of cytotoxic drug with minimal systemic concentrations. Current nanoparticle-based treatments are capable of combining modality-specific imaging contrast with high drug payload and large surface area targeting ligands for an advanced multipurpose therapy agent. The combinatory correlation between treatment and localization of disease models is exclusively exploited in the nanomedicine field. ‘Theragonism’ or ‘theranostic’ is a relatively new term which defines that multifunctional nanoparticle for personalized medicines as the imaging contrast provided allows tracking the efficacy of the therapy throughout the application. This personalization with concurrent monitoring of medical treatment becomes especially critical when considering diseases that are largely heterogeneous in nature such as cancer, whose current treatments are associated with emaciation and suffering, almost as highly as the disease.

This volume of *Topics in Medicinal Chemistry* is dedicated to discuss the current trend of the next-generation personalized medicine where we mainly focus on the role of nano-architectures and how defined chemistry helps to tune their functional properties for optimum performance in a biological system. For this thematic issue, we have invited the leading experts in this field to contribute. The special issue is comprised of seven review chapters, which includes one introductory chapter. The articles illustrate a presentation of the advancements related to the field of gene delivery, which we hope will stimulate designing better carriers and tune these technologies for basic, translational and clinical applications.

In the introductory article, Dr. Dipanjan Pan at the University of Illinois at Urbana-Champaign highlights the importance of ‘nano’ in personalized medicine. We briefly learn about the present status of this field in terms of their clinical

translation. In another lead article, Dr. Francesca Baldelli-Bombelli at the Politecnico di Milano and her collaborators highlight the importance of understanding the physico-chemical behaviour of the nanoparticles. This article reports on the state-of-art techniques for the physico-chemical characterization of nanoparticle-protein complexes in the biological environment with particular emphasis on their impact on the efficiency and safety of a new generation of nanomedicines. In a following article, Dr. Dipanjan Pan at the University of Illinois at Urbana-Champaign and his co-workers highlight the biological barriers faced by nanomedicines for effective targeting and delivery *in vivo*. Dr. Srinivasan Venkataraman at the Institute of Materials Research and Engineering in Singapore in his review article introduces the readers to the fascinating world of defined supramolecular assemblies derived from novel polymers for biomedical application. In the following two chapters, Dr. Dipanjan Pan and his colleagues at the University of Illinois at Urbana-Champaign review the present status of multimodal imaging and theranostic and nano-enabled delivery of intracellular therapeutics. In the concluding chapter, Dr. Dipanjan Pan at the University of Illinois at Urbana-Champaign critically reviews the status of the field and its potential to reach the clinic.

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Nanomedicine

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