Preface

Application of engineered nanoparticles (ENPs) in medicine has stimulated a wide range of interests in the past decades. On the other hand, the potential exposure of ENPs to humans has also been increasing with the development, manufacturing, and applications of engineered ENPs across a range of industrial and consumer products. Understanding of the bioactivity of ENPs is needed in order to better modulate their activities and regulate the potential risk. Recently, overwhelming research interests are on the investigation of bioactivities of ENPs, such as nanotoxicity, biocompatibility, ENP—biomolecule interactions, ENP—cell interactions, and cell targeting. Research papers have increased exponentially over the last decade. There is a consensus that we must have broad collaborations among chemists, engineers, toxicologists, cell biologists, and doctors in this endeavor.

This book collects papers from many international experts, who are working in diverse areas related to bioactivities of ENPs. In Chap. 1, the authors provide an overview of ENPs' ecotoxicological effects on algae to understand the underlying mechanisms of their effects on algae. Among the data available, ENPs have been shown to exert effects ranging from inhibitive to lethal due to high surface area, nanoscale size, and quantum effects. Chapters 2 and 3 discuss literatures concerning the uptake, translocation, accumulation, and physiological effects of surface-coated ENPs in vascular plants and higher plants. An important mechanism of nanotoxicity is reactive oxygen species (ROS) formation. ENPs' composition, size, shape, and surface chemistry all influence ROS generation. These are briefly discussed in Chap. 4. ENPs can enter human body through respiratory pathway, digestive tract, skin penetration, intravenous injection, and implantation. Interactions between ENPs and biomolecules, such as phospholipid, protein, DNA, and some other small biological molecules, form the chemical basis of ENPs' bioactivities. Investigation of interactions between ENPs and biomolecules is of great importance. In Chap. 5, authors discuss interactions between ENPs and biomolecules, and the effects of surface morphology, composition and modified groups on such interactions. Surface modification is a key approach to develop suitable ENP agents for disease diagnosis and drug delivery. A single and combination of surface engineering methods used for efficient delivery of nanocarriers to the requisite location are

discussed in Chaps. 6 and 7. Besides the targeting efficiency, efforts have been made in designing and improving biocompatibility, stability, safety, drug loading, delivery, imaging signals, and thermal- or photodynamic responses of ENPs. These are discussed in Chap. 8. The use of chemotherapy as one of the most conventionally therapeutic interventions in clinics results in an increasing chance of acquiring multidrug resistance. Chapter 9 highlights various aspects of Pluronic polymers, Pluronic conjugates, Pluronic nanotechnology, as well as their therapeutic implications for effective disease treatment by overcoming drug resistance. Besides laboratory synthesis, ENPs can also be formed in environmentally relevant conditions. Thermally and light-induced formation of silver ENPs and subsequent ecological effects are described in Chap. 10. Chapter 11 discusses the cytotoxicity and organ—systemic toxicity and in vivo genotoxicity of metallic ENPs. Liver is the major organ for disposition of ENPs. Chapter 12 discusses the accumulation of ENPs in liver and the induction of hepatic inflammation, DNA damage, hepatocyte death as well as liver fibrosis. Toxicity evaluation and bio-applications of silicon quantum dots synthesized by both physical and chemical methods are discussed in Chap. 13. Based on the multiple biological data from ENPs with various physicochemical properties, quantitative nanostructure—activity relationships (QNAR) modeling methods have been developed in Chap. 14 to analyze and evaluate the extent of biological activities potentially induced by various types of ENPs. Such methods are critical for both chemical risk assessment and more comprehensive evaluation of the potentially detrimental effects induced by a given ENP in a particular organism.

This book will interest a wide readership in the fields of chemical science, material science, engineering, biology, environment, and nanomedicine. We are indebted to the dedication and hard work by all authors and reviewers and the persistent convincing efforts by Dr. June Tang from Springer-Nature.

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