Cancer nanotechnology is a rapidly emerging field which holds great promise for revolutionizing cancer detection, diagnosis, treatment, and cure. Furthermore, cancer nanotechnology holds the potential to ultimately improve access to cancer care worldwide.

Early detection of cancer at the cellular level, even before anatomic anomalies are visible, is critical to more efficacious and cost-effective diagnosis and therapeutic advances. Non-invasive techniques are required that are capable of reliably imaging at the molecular scale – 100–1,000 cells as opposed to the current techniques that require more than a million cells for accurate clinical diagnosis.

In developing clinically viable cancer therapeutic protocols, targeted and localized delivery of the drugs are the key challenges. In other words, the goal is to target the delivery of the anticancer drugs to selectively attack the cancer cells, with minimal toxicity of the healthy tissue and other undesirable side effects. Current protocols of systemic application of anticancer drugs greatly limit the maximal allowable dose of the drug in order to minimize severe side effects, yet the application of a higher dosage of anticancer drugs is necessary to overcome rapid elimination and non-specific distribution of the anticancer drugs into organs and tissues. This practice often leads to severe side effects including unintended damage to healthy tissue and organs.

Most cancer nanotechnology advances are primarily focused on developing Nano-engineered materials that can significantly impact non-invasive molecular scale imaging techniques and targeted delivery of drugs. Further, multifunctional nanostructures are being developed that can simultaneously serve as contrast agents for enhanced imaging and nano-vectors for targeted drug delivery or therapies. However, it is critical to identify/synthesize specific biomarkers, which, when conjugated to nanostructures, will target them only to specific tumor sites.

The achievement of the goals of nanotechnology-mediated early cancer detection and more efficacious therapies requires synergistic integration and convergence of a variety of disciplines. These include cancer biology, materials science and engineering, biomedical engineering, toxicology, computer science and engineering, chemistry, physics, and mathematics. The chapters in this book describe the most recent, cutting-edge, “how-to” approaches developed/employed by researchers in a variety of disciplines to identify cancer-specific biomarkers, construct suitable multifunctional targeted nanostructure platforms, and their enhanced imaging and therapeutic applications.

Our interest in and energy for completing this project is derived from the excitement generated by our interdisciplinary collaborations in cancer nanotechnology at the University of Florida. It is our hope that the information provided in this compendium will likewise excite and encourage others to engage in such similar interdisciplinary collaborative efforts that will yield new knowledge, for it is these types of collaborations that are essential for translating cancer nanotechnology into a clinical reality for those suffering from these devastating diseases.

We trust that both the established and those embarking on their maiden research voyage in the field of cancer nanotechnology will find this treatise valuable.
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