



Nanotechnology for Biomedical Applications

Thomas Varghese

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Nanotechnology is an exciting new field of study that is attracting a lot of attention. The unusual mechanical, optical, electrical, and magnetic properties exhibited by nanomaterials with dimensions in the range 0.1 nm (the size of a single atom) to 100 nm can be exploited in a number ways and applied to a wide range of fields, such as public health, nutrition and environment, throughout society. Such applications have the potential to bring major changes in human health and may bring a transformation in the entire health care system.

Nanotechnology provides numerous new instruments for research into the basic biochemical and biophysical processes of both healthy and diseased cells. The resulting knowledge can be used as a basis for developing new prevention strategies and therapies. In addition, intensive research efforts are focusing on potential uses of nanotechnology in the field of medicine. The enormous increase in our knowledge of the human genome and proteins is making it easier to understand diseases in terms of anomalies at the molecular level. This provides opportunities for very early diagnosis and early treatment before the initial symptoms of the disease have appeared.

Nanotechnologies offer the possibility of improving existing methods and instruments for in vitro detection of molecular biomarkers in patient's urine or tissue samples and for identifying pathogenic bacteria and viruses. This technology is already leading to smaller, more compact and more sophisticated analytical instruments and cheap disposable components, thereby expanding opportunities for point-of-care applications. Human health could also benefit from the use of nanotechnologies in agriculture, food sector, and environmental management.

Biomedical nanotechnology is one of the fastest-growing research fields across the globe. It includes researches in nanodrugs, drug delivery, prostheses, implants, diagnostics and imaging technologies. In future, nanotechnology using different biosensors will be able to diagnose ailments in much earlier stage of disease. It can overcome anatomical and physiological barriers to deliver drugs more effectively to the target sites to reduce nonspecific effects. Imaging plays a vital role in the detection of pathologies like tumours or vascular pathologies. The use of novel contrast agents based on nanoparticles improves the existing imaging techniques for in vivo diagnosis. Magnetic nanoparticles are under extensive investigation to improve magnetic resonance imaging (MRI) capability for early detection of diseases.

The book focuses on some of the above-mentioned aspects of nanotechnology. It covers virtually everything within present and future research and the development of biomedical nanotechnology. It will be useful for undergraduate and postgraduate students of science, technology and medicine, and researchers in these fields.

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