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Nanoparticles for Targeting and Multi-Stimuli responsive Nano Drug Delivery application

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ABSTRACT

Various polymeric nanoparticles (NPs) with optimal size, tumor-targeting functionalization, or microenvironment sensitive characteristics have been designed to solve several limitations of conventional chemotherapy. Nano-sized polymeric drug carrier systems have remarkably great advantages in drug delivery and cancer therapy, which are still plagued with severe deficiencies, especially insufficient cellular uptake. Therapeutic nanoparticle (NP) technologies have the potential to revolutionize the drug development process and change the landscape of the pharmaceutical industry[1-5] . By virtue of their unique physicochemical properties, nanoparticles have shown promise in delivering a range of molecules to desired sites in the body.Nanoparticle technologies may improve the therapeutic index of drugs by enhancing their efficacy and/or increasing their tolerability in the body. Nanoparticles could also improve the bioavailability of water-insoluble drugs, carry large payloads,protect the therapeutic agents from physiological barriers, as well as enable the development of novel classes of bioactive macromolecules (e.g., DNA and siRNA).Additionally, the incorporation of imaging contrast agents within nanoparticles can allow us to visualize the site of drug delivery or monitor the in vivo effi cacy of the therapeutic agent [6-7] . Thus far, over two-dozen nanotechnology products have been approved by the US Food and Drug Administration (FDA) for clinical use, and many are under clinic and preclinic development [2,8,9] . Interestingly, the majority of these clinically approved, fi rst-generation nanotechnology products are comprised of liposomal drugs and polymer–drug conjugates, which are relatively simple and generally lack active targeting or controlled drug release components.To develop safer and more effective therapeutic nanoparticles, researchers have designed novel multifunctional nanoparticle platforms for cell/tissue-specifi c targeting, sustained or triggered drug delivery, co-delivery of synergistic drug combinations, etc. Among these functions, we believe that spatial and temporal controls in drug delivery may be critical for the successful development of next-generation nanotechnology products [5] .

Keywords: Nanoparticles, Drug delivery, Liposome, Polymeric NP, Lipid-Polymer hybrid NP, Dendrimer, Active targeting nano drug delivery, Passive targeting nano drug delivery,stimuli responsive nano carrier

1. INTRODUCTION

Nanotechnology and nanoscience are widely seen as having a great potential to bring benefits to many areas of research and applications. It is attracting increasing investments from governments and private sector businesses in many parts of the world. Concurrently, the application of nanoscience is raising new challenges in the safety, regulatory, and ethical domains that will require extensive debates on all levels. The prefix *nano* is derived from the Greek word *dwarf*. One nanometer (nm) is equal to one-billionth of a meter, that is, 10^{-9} m. The term "nanotechnology" was first used in 1974, when Norio Taniguchi, a scientist at the University of Tokyo, Japan, referred to materials in nano meters. The size range that holds so much interest is typically from 100 nm down to the atomic level approximately 0.2 nm, because in this range materials can have different and enhanced properties compared with the same material at a larger size.