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THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY
Division of Life Science

LIFS Seminar Series

Probing the "nano-bio" interactions between DNA-based nanostructures and the cell

by

Dr. Jonathan C.H. CHOI
Department of Electronic Engineering
The Chinese University of Hong Kong

Abstract

Intracellular delivery of nucleic acids as gene regulation agents typically requires the use of cationic carriers or viral vectors, yet issues related to cellular toxicity or immune responses hamper their attractiveness as therapeutic candidates. The discovery that spherical nucleic acids (SNAs), polyanionic structures comprised of densely packed DNA oligonucleotides covalently attached to the surface of a nanoparticle core, can effectively enter more than 50 different cell types presents a potential strategy for overcoming the limitations of conventional transfection agents. Indeed, as an emergent class of bionanomaterials, SNAs have been shown to be effective for intracellular diagnostic assays and as novel gene regulation agents.

My presentation will explore how SNAs fundamentally interact with cells from three different perspectives. I will first introduce a biological mechanism that governs the cellular uptake of SNAs, pointing out that the rapid cellular uptake kinetics and intracellular transport of SNAs stem from the arrangement of DNA oligonucleotides into a three-dimensional architecture. Specifically, I will delineate the specific pathway and receptor proteins involved in the process of endocytosis. Based on these mechanistic insights, I will then propose materials design rules for SNAs such that their ability to enter cells and deliver therapeutic cargoes can be maximized. Finally, I will articulate the intracellular fate of SNAs following their cellular entry, indicating that the trafficking events of SNAs do not depend on the nanoparticle core and DNA sequence. In particular, I will provide evidence for the disassembly of SNAs into constituent components inside intracellular compartments as well as their differential recycling out of the cell.

These results reinforce the notion that SNAs can serve as therapeutic payloads and targeting structures to engage biological pathways not readily accessible with linear oligonucleotides. They also underscore the importance of designing next-generation bionanomaterials that can bypass the degradation bottleneck imposed by their residency within intracellular compartments.

Date : 25 November 2014 (Tuesday)
Time : 4:30 pm
Venue : Lecture Theatre F (near Lift no. 25/26)
The Hong Kong University of Science & Technology, Clear Water Bay, Kowloon

(Host faculty : Dr. Karen Chan)

All are Welcome!