Department of Biomedical Sciences and Department of Biomedical Engineering, CityU

presents

Title: Nano–Cell Interactions of Non-Cationic Bionanomaterials

Speaker: Professor Jonathan Choi, Department of Biomedical Engineering, CUHK

Date: 3 April 2023 (Monday)

Time: 15:30- 17:00

Venue: LT16 Benjamin Kwok Lecture Theatre, Level 4, YEUNG Building, CityU

Brief biography:

Jonathan Choi is an Associate Professor in the Department of BME and School of Life Sciences (by courtesy) at CUHK. He received his BS/MS degrees from Stanford in 2005/2006 and his PhD degree from Caltech in 2011, all in chemical engineering. He established the first lab that focuses on in vivo nanoparticle-based drug delivery and bio-nano interactions in Hong Kong in August 2013 and co-founded CUHK BME in July 2017, the first BME department in Hong Kong. He is an editorial board member of *Pharmaceutics* and was a guest editor of *Molecular Pharmaceutics*. He was Communications Chair of the Controlled Release Society (CRS) Bioinspired and Biomimetic Delivery Focus Group from 2020 to 2022. He received a Croucher Innovation Award in 2016 and served as Assistant Dean (Student Affairs) of Engineering at CUHK from 2018 to 2021.

Abstract:

One rational approach to facilitating the intracellular delivery of nanomedicines is to dissect how nanoparticles (NPs) interact with cells. Cationic, lipid NPs are classical drug carriers due to their high penetration across the negatively charged cell membrane, but they tend to cause cytotoxicity and immune response. Non-cationic NPs (neutral or anionic) generally show higher biocompatibility but enter cells less abundantly. Intriguingly, some types of non-cationic NPs exhibit high biocompatibility and cellular uptake properties, both attractive features for delivery. For these reasons, we are interested in the cell-nano interactions of such special non-cationic NPs and aim at exploring nanomedicine applications based on their cell-nano interactions.

The first half of the talk will focus on near-neutral “alkylated gold NPs” with minute amounts of alkyl chains on the gold core. In vitro, alkylation can (i) boost cellular uptake by up to 100-fold when nanosubstrate roughness is introduced to the extracellular milieu for upregulating pathways of endocytosis and can (ii) upregulate genes related to vesicles and promote the exocytosis of NPs via organelle-based secretion. In vivo, alkylation governs not only the association of inhaled NPs to different lung cell types, but also how topically applied NPs associate with cells in psoriatic skin of mice. Despite the lack of chemical or biological drugs, the “self-therapeutic” alkylated gold NPs inhibit genes linked to the interleukin-17 pathway and treat psoriasis as effectively as standard steroid and vitamin D analog therapy.

The second half of the talk will feature “spherical nucleic acids (SNAs)”, anionic nanospheres derived from the attachment of oligonucleotides to a NP core. In vitro, NP parameters and cellular processes jointly impact cell-nano interactions, say the effects of (i) NP shape and class A scavenger receptor (SR-A) on endocytosis and (ii) oligonucleotide sequence and Rho-ROCK mechanotransduction on intracellular trafficking. In vivo, SNAs preferentially associate with SR-A-rich macrophages and endothelial cells in plaques upon intravenous injection into mice with atherosclerosis, thus empowering gene delivery to plaques at 1.2% of the dose. Repeated injections of microRNA-146a-based SNAs reduced plaques and inhibited genes along the NF-kB proinflammatory pathway without inducing systemic toxicity.

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