The Chinese University of Hong Kong

Department of Biomedical Engineering

Graduate Seminar – PhD Oral Defence

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Date	:	23 May 2019 (Thursday)
Time	:	4:30 pm
Venue	:	Room 513, William MW Mong Engineering Building (ERB)

Title: Conformationally-dynamic and stimuli-responsive Polymeric Nanomaterials for Multiscale Biomedical Engineering Applications

The ability to precisely control the structure and the function of synthetic materials have attracted considerable research interest over the past two decades. Especially, the bottom-up preparing of polymeric biomaterials has profound significance because molecule level designs are critical to regulating the properties and functions of biomaterials at various scales. Cyclized or folded single chain polymeric nanoparticles or nanogels (SCNPs or SCNGs) are emerging single chain polymeric nano-objects which can be used for such molecular tailoring. In conventional methods, SCNPs are generally produced by collapsing individual polymer chains with delicate synthetic designs under highly dilute conditions. As an alternative, SCNGs are another category of cyclized/knotted single chain polymers, which can be prepared by reversible- deactivation radical polymerization method by kinetically controlling chain propagation with low monomer conversion rates. These intrachain folding techniques make it difficult to prepare single chain nano-objects with customized functions on a large scale and severely hinder the wide-spread applications of single chain nano-objects. To achieve the building-up biomaterials from molecular level, I first developed a novel method for preparing SCNGs with significantly improved efficiency than that of previous methods. Enabled by this scalable synthesis strategy, I designed various single chain-based biomaterials and further investigated the impact of the dynamic molecular conformational change of SCNGs on cellular interactions in different biomedical applications at varying scales. The supramolecular unfoldable SCNGs showed excellent cytocompatibility and effectively delivered siRNA into stem cells to induce lineage-specific differentiation in a conformation-dependent manner. Furthermore, the using of these SCNGs as a dynamic tether for bioactive ligands on cell culture substrates facilitated tunable nanoscale presentation and ligation of ligands to the cell receptors, thereby regulating the adhesion and mechanotransduction signalling of stem cells. Lastly, I used the SCNGs obtained from the scaled-up synthesis as building blocks to fabricate bulk hydrogels through a molecularly-tailored approach. The obtained hydrogels demonstrated effective energy dissipation, due to the reversible conformational change of SCNGs, thereby effectively protecting the encapsulated stem cells from deleterious mechanical shocks.

***** ALL ARE WELCOME *****

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