Department of Mechanical Engineering The University of Hong Kong

SEMINAR

Title: **Multiphase microdroplets for constructing organelloids and celloids**

Speaker: **Dr. Wei Guo**
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Date: **June 19, 2023 (Monday)**

Time: **3:30pm – 4:15pm**

Venue: **Room 7-34/35, Haking Wong Building**

Abstract:
Liquid-liquid phase separation (LLPS) has recently been demonstrated as a key mechanism for the formation of intracellular membraneless organelles, providing novel insights into prebiotic compartment assembly on early Earth. By creating liquid compartments that mimic the microenvironments found within organelles and cells, which could term as 'organelloids' or 'celloids,' LLPS presents promising approaches for the development of carriers and reactors in drug screening and therapeutic applications. In this presentation, I will discuss my research on the fundamental principles of LLPS and explore the potential of integrating LLPS with microfluidic high-throughput screening techniques for the construction of the next-generation drug screening systems.

First, I will demonstrate evaporation-triggered segregative liquid-liquid phase separation (LLPS) within a single-phase sessile droplet of a polyethylene glycol (PEG) and dextran mixture. I will discuss the kinetic pathway of phase separation, triggered by the non-uniform evaporation rate and the Marangoni flow-driven hydrodynamics within the sessile droplet. More importantly, this evaporation-triggered phase-separating system creates an ideal microenvironment for prebiotic compartmentalization, as evidenced by the localization and storage of nucleic acids, *in vitro* transcription, and a three-fold enhancement of ribozyme activity. Next, I will explore the associative phase separation of RNA oligonucleotides and cationic peptides, demonstrating that RNA-peptide condensates exhibit tunable material properties across a broad range due to interactions influenced by RNA folding/unfolding kinetics. These tunable material states can lead to distinct microenvironments, which further regulate biochemical processes such as RNA aptamer compartmentalization and RNA cleavage reactions. Lastly, I will discuss the potential of incorporating LLPS into a microfluidic high-throughput screening platform, which could offer significant advantages over traditional water-in-oil emulsion-based microfluidic screening systems in various aspects, such as addressing the long-standing 'off-target' problem. Overall, these findings illustrate how the fundamental principles of LLPS can be harnessed to create diverse 'organelloids' for different biochemical processes, offering enormous potential for the next-generation drug screening systems.

ALL INTERESTED ARE WELCOME
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