School of Materials Science and Engineering

Seminar Topic:
Liquid-Liquid Phase Separation of Extra-Cellular Biological Materials: Molecular Mechanisms and Translational for Biomedical Applications

Associate Professor Ali Gilles Tchenguise Miserez

Abstract

Living organisms constitute a formidable source of inspiration that may help solve critical society and healthcare challenges. Indeed, the Living World produces complex and high-performance materials using aqueous chemistry, at ambient temperature and pressure, and with naturally-occurring chemicals. If we want to harness this sustainable chemistry, we need to fundamentally understand how biology produces natural materials. This includes elucidating the biochemistry of their building blocks, how these blocks self-assemble across multiple hierarchical levels, and establishing structure/property/function relationships from the molecular and genetic level up to the macroscopic scale. I will present our pioneer efforts in this area integrating Life Sciences (RNA-sequencing, high-throughput proteomics, protein biochemistry) with Physical Sciences (multi-scale materials characterization, polymer chemistry), which have led to discoveries of new molecular designs and to a deeper understanding of how biological materials are fabricated by living organisms.

I will highlight a case study of a hard "biotool", namely the beak of squids that are entirely made biomacromolecular components, *i.e.* chitin and structural proteins. I will describe the main proteins we have discovered and sequenced in the beak, which we have shown to exhibit liquid-liquid phase separation (LLPS), a mechanism that appears to be critical for the natural fabrication of the beak and many other biological hard tissues. I will also present our translational efforts in exploiting LLPS of beak proteins and peptides for the efficient encapsulation and stimuli-responsive release of various therapeutics, in particular emphasizing that micro-droplets formed by LLPS offer new opportunities for direct cytosolic delivery of therapeutics.

Biography

Associate Professor Ali Miserez is a Faculty member at the Schools of Materials Science and Engineering and Biological Sciences in NTU. He obtained his PhD (2003) from EPFL (Switzerland) in Materials Science and Engineering in the field of composite materials and mechanics of materials. In 2004, he moved to UC Santa Barbara as a Post-doctoral Fellow supported by a Swiss National Science Foundation Fellowship, where he expanded his research interest towards biomimetic engineering and biochemistry of extra-cellular tissues. He joined NTU in 2009, and he was awarded the Singapore National Research Foundation Fellowship in 2011.

Dr Miserez's research is centered on revealing the molecular, physico-chemical, and structural principles from unique biological materials, and on translating these designs into novel biomimetic materials. His work has appeared in both general (*Science, Nature Materials, Nature Biotechnology, Nature Chemical Biology*) and specialized journals (*Biomacromolecules, Advanced Materials, JBC, Polymer Chemistry, etc*). He has delivered numerous invited talks, including at Gordon Research Conferences in the field of bioinspired materials and biomineralization.

Wednesday, 21 October 2020 ǁ Time: 2:00 pm - 3:00 pm ǁ
Live Streaming Link (Zoom Meeting): https://ntu-sg.zoom.us/j/98021643717
Meeting ID: 980 2164 3717 Passcode: 211020
Hosted by: Associate Professor Alfred Tok

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