NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

School of Materials Science and Engineering

Seminar Topic:
Discovering New Bio-insights and Therapeutic Opportunities at the Nexus of Materials Science, ROS Biochemistry and Nanotechnology

Assistant Professor Dalton Tay

Abstract

The occurrence of the Great Oxidation Event (GOE) some 2.4 billion years ago has fundamentally changed the biochemical landscape of living organisms. The evolution of aerobic metabolic processes has led to the inevitable production of reactive oxygen species (ROS) as by-products in the mitochondrial respiratory chain. ROS are chemical derivatives of the molecular oxygen that are formed by redox reactions or by electronic excitation. For a long time, ROS were viewed as a deleterious agent implicated in various pathological conditions. However, in recent years, there is a growing body of evidence to suggest that ROS can serve as important functional signaling entities to regulate a plethora of physiological processes. Inspired by the unique features of ROS in biological systems, our lab has developed numerous material-based strategies and platforms to manipulate cellular redox metabolisms via the “inside-out” and “outside-in” mechanisms.

In this talk, I will first present several structure-activity relationships studies of inorganic nanoparticles that were conducted in our lab in relation to their ROS generating properties. Insights gained from these studies have led to the recent development of a new class of ROS generating nanoscopic functionalized porous nanoparticles with intrinsic cancer-selective and -killing properties. The potential clinical utility of the “self-therapeutic” nanoparticles was validated using a panel of cell lines and breast cancer xenograft model. Specially, we showed that tumor growth can be significantly suppressed even without the incorporation of any drugs nor application of external stimuli to the nanomedicine. In the second part of the talk, I will introduce the emerging concept of “mechano-redox transduction”, whereby cells were found to respond to changes in materials stiffness by altering its intracellular redox status and associated signaling events. Using a series of mechanically tunable mono and hybrid hydrogel systems, coupled with omics technologies and bioinformatics, we showed that it is possible to exploit this phenomenon to develop a new form of “cell-free” therapy in regenerative medicine, as well as to restrain tumor invasion. It is anticipated that these materials-driven redox modulation strategies are posited to advance the future development of ROS-centric therapeutics and biomedical applications.

Biography

Dr Dalton Tay is currently an Assistant Professor in the School of Materials Science and Engineering (MSE) and School of Biological Sciences (SBS), Nanyang Technological University (NTU) Singapore. He earned his BEng (1st Class Honors) and PhD from MSE, NTU, in 2007 and 2012 respectively. In 2012, he joined the National University of Singapore (NUS) as the sole recipient of the Lee Kuan Yew (LKY) postdoctoral fellowship in the Department of Chemical and Biomolecular Engineering.

His overarching research interests are highly multi-disciplinary and span over the fields of cell-materials interaction, redox biochemistry, nanotechnology, hydrogels for biomedical applications, mechanobiology and waste materials valorization.

Wednesday, 29 July 2020 ǁ Time: 2:00 pm – 3:00 pm ǁ
Live Streaming Link (Blackboard Collaborate):
https://au.bbcollab.com/guest/c579bdb525d245df966fd81374ca1deb
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