Bioprocessing Technology Institute
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Don't forget to flow: Paracrine-induced patterning of human pluripotent cells in early lineage commitment and organoid development

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BTI Boardroom, 20 Biopolis Way, #06-01 Centros, Singapore 138668
Host: Dr Liu Dan, Bioprocessing Technology Institute, A*STAR
Register Here: https://form.gov.sg/62972dd5c3cb81001293bded

Seminar Abstract

The use of stem cells (whether multi- or pluripotent (MSCs, PSCs)) in cell therapies, regenerative medicine and drug screening and discovery requires the imposition of exquisite control over their fate to efficiently produce sufficient, defined single or multi-cell populations (including most recently organoids). Further improvements in expansion and differentiation outcomes, along with patterning and maturation of specific cell types, are however often intrinsically limited by undefined media culture components, poorly (or un-) known signal crosstalk between multiple exogenous and endogenous (secreted) factors, and spatiotemporal variations in microenvironmental composition inherent to conventional bioprocess culture and bioreactor formats. To address these limits, and elucidate new factor combinations and factor interplay, we have recapitulated early lineage choice and tissue patterning events within perfused arrayed microtissue-scale environments, coupled with single cell imaging cytometry and multivariate analysis. These multiplexed microdevices have allowed us to explore up to 8100 unique media conditions under flow conditions mimicking interstitial tissue flows in an unbiased and quantitative manner to rapidly decipher factor interplay and signaling hierarchies that control stem and progenitor cell fate choices. Most recently, we have used this factorial approach to reveal critical contributions of induced paracrine factors on cell specification of the primitive streak and thereafter patterning into multilayered organoids, along with isolation of media combinations that achieve near pure differentiated tissue cell types. Whilst this sophisticated but facile microdevice-based methodology can be used for tuning complex differentiation such as nephron segmentation, it opens a robust pathway for interrogating other multicellular differentiation processes and organoid development and maturation, in addition to the necessary bioprocess optimization and media formulation design required for scale-up of these complex systems.

About the Speaker

Professor Justin J. Cooper-White currently holds the positions of Head of School and Professor of Bioengineering in the School of Chemical Engineering (UQ), Senior Group Leader in the Australian Institute for Bioengineering and Nanotechnology (UQ), Director of the Australian National Fabrication Facility - Queensland Node (ANFF-Q), Co-Director of the UQ Centre in Stem Cell Ageing and Regenerative Engineering (UQ-StemCARE), and Editor-in-Chief of APL Bioengineering (American Institute of Physics Publishing (New York)). Prof. Cooper-White has over 230 journal papers in high impact journals in the field of Bioengineering (including Nature, ACS Nano, Science Advances, Nature Communications, Nature Protocols, Nature Microbiol., Biomaterials, Lab on a Chip, Cell Stem Cell, Stem Cells Trans. Med., Integrative Biology and APL Bioengineering). He has produced 6 Worldwide patent families that have reached National Phase Entry (in USA, Europe, and Australia) and been commercialized in the areas of formulation design for agriproducts, microbioreactor arrays and tissue engineering scaffolds. He has received numerous awards and fellowships, including most recently Fellow of the International Union of Societies for Biomaterials Science and Engineering (IUSBSE, 2020), CSIRO Office of the Chief Executive Science Leader Fellowship (2013-2018), and the NHMRC Marshall and Warren Award for Research Excellence (2015-16). His research focuses on understanding the role of microenvironmental cues (primarily on those mechano-related) on stem cell commitment and tissue genesis, and the critical roles that stem cells and their niches play in systemic losses of tissue and organ function as we age. His team applies this understanding to develop biomicrodevices, engineered surfaces and advanced scaffolds for cell therapy and engineering tissue replacement or repair, and more recently, nanoparticles for targeted rejuvenation of our aged tissues.

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