

BiophysTO Lunchtime Seminar Series

Date

Thursday, January 25, 2018

12:10 pm

Location

McLennan MP606

60 St George

Streaming

Seminar livestreamed to

DV3129 @ UTM

Pizza & refreshments

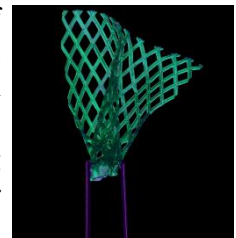
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Milica Radisic

Institute of Biomaterials and Biomedical Engineering,
Department of Chemical Engineering & Applied Chemistry,
University of Toronto and Toronto General Research
Institute

Microfabrication of elastomeric polymers for organ-on-a-chip engineering and injectable tissues

Recent advances in human pluripotent stem cell (hPSC) biology enable derivation of essentially any cell type in the human body, and development of three-dimensional (3D) tissue models for drug discovery, safety testing, disease modelling and regenerative medicine applications. However, limitations related to cell maturation, vascularization, cellular fidelity and inter-organ communication still remain. Relying on an engineering approach, microfluidics and microfabrication techniques our laboratory has developed new technologies aimed at overcoming them.



Since native heart tissue is unable to regenerate after injury, induced pluripotent stem cells (iPSC) represent a promising source for human cardiomyocytes. Here, biological wire (Biowire) technology will be described, developed to specifically enhance maturation levels of hPSC based cardiac tissues, by controlling tissue geometry and electrical field stimulation regime (Nunes et al Nature Methods 2013). We will describe new applications of the Biowire technology in engineering a specifically atrial and specifically ventricular cardiac tissues, safety testing of small molecule kinase inhibitors, potential new cancer drugs, and modelling of left ventricular hypertrophy using patient derived cells.

For probing of more complex physiological questions, dependent on the flow of culture media or blood, incorporation of vasculature is required, most commonly performed in organ-on-a-chip devices. Current organ-on-a-chip devices are limited by the presence of non-physiological materials such as glass and drug-absorbing PDMS as well as the necessity for specialized equipment such as vacuum lines and fluid pumps that inherently limit their throughput. An overview of two new technologies, AngioChip (Zhang et al Nature Materials 2016) and inVADE (Lai et al Advanced Functional Materials 2017) will be presented, that overcome the noted limitations and enable engineering of vascularized liver, vascularized heart tissues and studies of cancer metastasis. These platforms enable facile operation and imaging in a set-up resembling a 96-well plate. Using polymer engineering, we were able to marry two seemingly opposing criteria in these platforms, permeability and mechanical stability, to engineer vasculature suitable for biological discovery and direct surgical anastomosis to the host vasculature.

Finally, to enable minimally invasive delivery of engineered tissues into the body, a new shape-memory scaffold was developed that enables delivery of fully functional tissues on the heart, liver and aorta through a keyhole surgery (Montgomery et al Nature Materials 2017).

Host: Dr. Anton Zilman



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