Notice of the Final Oral Examination
for the Degree of Doctor of Philosophy

of

KAITLYN RAMSAY

BSc Hons. (Queen’s University, 2017)

“Bottom-up generation of synthetic cells and tissues using microfluidic devices for double emulsion generation”

Department of Chemistry

Tuesday, June 8, 2021
9:00 A.M.
Conducted Virtually

Supervisory Committee:
Dr. Katherine Elvira, Department of Chemistry, University of Victoria (Supervisor)
Dr. Lisa Rosenberg, Department of Chemistry, UVic (Member)
Dr. Mohsen Akbari, Department of Mechanical Engineering, UVic (Outside Member)

External Examiner:
Dr. Steve Shih, Department of Electrical and Computer Engineering, Concordia University

Chair of Oral Examination:
Dr. Matthew Murphy, Peter B. Gustavson School of Business, UVic

Dr. Stephen Evans, Acting Dean, Faculty of Graduate Studies
Abstract

Synthetic cells and tissues engineered from the bottom-up using non-living building blocks have many potential applications in medicine and biochemistry. Nonetheless, the applications of these synthetic cells and tissues remain limited by virtue of the challenging, costly, and uncontrollable methodologies available for their construction. Droplet microfluidic techniques, which are powerful analytical tools that can be used for the accurate and precise control over micro-sized droplets, offer potential solutions to these problems. The development of these droplet microfluidic platforms is a burgeoning and challenging field, with room for many impactful innovations. In the following dissertation, I first show the development of two different droplet microfluidic platform for the generation of two variations of synthetic cells: the first from polymeric-based building blocks and the second from biomimetic lipid-based building blocks. I then use the former of these platforms for the bottom-up generation of functional synthetic tissues (also known as prototissues). Using these techniques, I am able to elicit previously elusive structural and behavioral information. These methods contribute towards the creation of superior mimics of sophisticated life-like structures as well as a better understanding of how bespoke microfluidic platforms can be engineered to yield reliable and reproducible results. I have shown that microfluidic technologies are an invaluable tool for the creation and study of life-like systems and that these synthetic cells and tissues open up new avenues for research into multidisciplinary applications.