Notice of the Final Oral Examination
for the Degree of Master of Science

of

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BSc (University of Victoria, 2017)

“Modification of aspect ratio and surface charge to decrease sequestration of MRI contrast nanomaterials”

Department of Chemistry

June 9, 2020
1:00 P.M.
Remote Defence

Supervisory Committee:
Dr. Frank Van Veggel, Department of Chemistry, University of Victoria (Supervisor)
Dr. Fraser Hof, Department of Chemistry, UVic (Member)

External Examiner:
Dr. Julian Lum, Department of Biochemistry and Microbiology, UVic

Chair of Oral Examination:
Dr. Geoffrey Steeves, Department of Physics and Astronomy, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies
Abstract

Contrast agents for magnetic resonance imaging (MRI) are but one of a variety of nanosystems that have incredible potential for the detection and diagnosis of cancer. Nanosystems share a common disadvantage: they are quickly sequestered by biological processes that clear foreign material from the body, requiring ever larger doses to accumulate in targets, and reducing their overall effectiveness and viability. This thesis explores a pair of strategies for nanomaterials to boost their evasiveness from these defensive systems in the context of lanthanide MRI contrast agents, in an attempt to increase their probability to collect in cancerous tissue. Chapter 1 provides precedent and rationale for the modification of two parameters regarding novel nanosystem design: aspect ratio and zeta potential. Chapter 2 details the controlled syntheses and analysis of sodium dysprosium fluoride nanomaterials at a range of aspect ratios. Chapter 3 concerns the construction of tunable zwitterionic polymer coatings for synthesized nanomaterials to demonstrate control over the zeta potential in aqueous dispersion. Chapter 4 tests polymer-coated spherical nanoparticles and nanorods for internalization into or adsorbance onto a cancerous cell line. Chapter 5 summarizes the work of the previous chapters and suggests future research approaches. Though internalization or adsorbance onto HeLa cells was not observed for prepared nanomaterials, control over their aspect ratio at the synthetic level and zeta potential via constructed zwitterionic polymers was demonstrated, with implications for application to a plethora of nanosystems.