Faculty of Engineering and Applied Science
Chemical Engineering Seminar Series

Queen's University

In situ gelling-hydrogels for medicine and diagnostics

Dr. Todd Hoare/McMaster University
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ABSTRACT

Hydrogels have been widely used in a variety of biomedical and biosensing applications due to their favourable mechanical properties (mimicking those of soft tissues *in vivo* while facilitating high sensor flexibility), typically low non-specific protein adsorption (minimizing inflammation *in vivo* and reducing sensor interference), and capacity for controlling diffusion (enabling prolonged drug release *in vivo* and non-covalent biomolecule immobilization on biosensors). However, the elasticity of conventional pre-formed hydrogels limits their capacity to be delivered via injection *in vivo* or printed in 2D or 3D geometries to develop functional sensor coatings or structured biomaterials. In this context, *in situ*-gelling hydrogels that can spontaneously gel following mixing of functionalized precursor polymers can substantially expand the scope of potential hydrogel applications. In this presentation, I will discuss recent work from my laboratory focused on designing and exploiting the properties of hydrazone crosslinked poly(oligoethylene glycol methacrylate) (POEGMA) hydrogels formed by simple mixing of hydrazide and aldehyde-functionalized POEGMA oligomers. The hydrazone crosslinking chemistry is kinetically independent from body chemistry and enables fast (as low as <1 s) gelation times, while the POEGMA backbone can be engineered to be either highly protein-repellent (analogous to poly(ethylene glycol)) or temperature-responsive. Applications of these hydrogels for creating injectable long-term drug delivery vehicles for protein-based therapeutics, tissue scaffolds with the capacity to be used as cell carriers and/or support the growth of functional aligned or non-aligned tissues, functional paper-based lateral flow bioassays for high-resolution antigen detection, and cellulose-supported multiwell bioassays for drug discovery will be described, emphasizing the linkages between the engineered properties of the various hydrogel structures to their application performance.