Department of Chemistry & Biomolecular Science
Clarkson University
PhD Defense

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will speak on

Rational Design of Versatile Alginate Hydrogels for Smart Delivery of Drugs

Abstract: Novel therapeutic treatments have been enhanced by the use of smart drug delivery systems (SDDS). These drug carriers can transport and deliver drugs on-target or in response to specific stimuli, thus increasing efficacy and efficiency while decreasing side effects and undesired immune responses of the therapy. Several drug delivery systems have been developed in recent years, but among them, hydrogels are excellent candidates due to their high water content, which makes them excellent candidates for water-based biological environments such as human fluids. Among the ever-increasing polymeric systems that can form hydrogels, alginate hydrogels have been widely used in drug delivery owing to their availability, biocompatibility, porosity and drug encapsulation efficiency. A draw back however is that the payload can rapidly diffuse through the pores, compromising the on-target or stimuli-triggered release of the drugs. The main objective of this work was to control the porosity of the alginate hydrogel in order to decrease the premature leakage of drugs. We developed two different strategies to block the pores of the alginate hydrogel. The first was based on the coating of the alginate with a multi-branched polymer which was then covalently bonded to the alginate, blocking surficial hydrogel pores. The second approach used the interpenetration of a highly dense cross-linked polymer network within the hydrogel to block internal and surficial pores. Both strategies decreased leakage of a wide range of payload (DNA and proteins) by 10-20 fold. The "pore blocking" polymers were selected because of their high sensitive stimuli-responsive degradation in the presence of reactive oxygen species (ROS). In the presence of hydrogen peroxide, the degradation of the polymer entailed the "reopening" of the original pores, resulting in much faster release rates of payload. Subsequently, the incorporation of enzymes and nanoparticles within the hydrogel was exploited for the design of SDDS macro and microscopic (bio)(nano)composite hydrogels that could release active payload (i.e. DNA, insulin, Trastuzumab) in response to endogenous stimuli (i.e. glucose, lactate, H_2O_2, hypoxanthine) and exogenous stimuli (i.e. magnetic field) both in buffer and human serum solutions. These endogenous stimuli can serve as biomarkers of certain disorders (*e.g.,* diabetes, hypoxia, cancer). Ultimately, the sensing of these biomarkers can be extended to drug release processes, converting them to theranostics that could revolutionize human healthcare.

Thursday, April 28, 2022, 10:00 am EST

In-Person Location: BH Snell 330

Petersen Board Room

ZOOM Meeting Link:

https://clarkson.zoom.us/j/9178039340