Development of Microgel Systems for Evaluation and Modulation of Biological Responses

Microgels are colloidally stable, hydrogel microparticles that have previously been used in a range of biomaterial applications due to their tunable mechanical and chemical properties. Microgel-based materials provide an unparalleled level of control over material properties, such as mechanics and degradation rates, compared to bulk gels with the same polymer composition. Because of this diversity, microgels can be used in a wide array of applications including drug delivery/encapsulation, regenerative medicine, hemostasis, sensing and material self-healing. In this talk, I will discuss recent work utilizing microgels for development of hemostatic materials and for controlling cell fate.

Clot formation is critical to the cessation of bleeding and involves the formation of a platelet plug embedded within a fibrin mesh, however, clot formation is impaired during hemorrhaging due to massive dilution of platelets and other critical clotting factors. During clot formation, platelets bind multiple fibrin fibers thereby cross-linking and stabilizing the developing clot. We have designed platelet-like particles (PLPs) that mimic this feature of natural platelets by interacting with fibrin with high affinity and specificity at the site of injury through molecularly evolved fibrin-recognition sites. To maximize interactions with fibrin networks, we utilize highly deformable, ultra-low crosslinked pNIPAm microgels with multiple sites for chemoligation as the base material for our PLPs. These PLPs are capable of recapitulating key features of natural platelets, including induction of clotting in vitro in an endothelialized microfluidic device, augmentation of hemostasis in an in vivo traumatic injury model and induction of clot contraction, demonstrating the success of our design. In additional to their utility as a hemostatic material, PLPs are also highly promising for tissue engineering applications, due to their ability to induce fibrin network collapse. PLP-mediated modification of fibrin networks could provide mechanical cues to surrounding cells. Because mechanical stimulation has been shown to enhance wound-healing events, such as angiogenesis, incorporation of PLPs into fibrin based tissue engineered constructs could increase their wound healing capabilities. These results demonstrate the utility of microgel-based systems for novel biomaterial design and for controlling cell fate and tissue engineering applications.

About the speaker: Dr. Brown received her B.S. from Clemson University in Biosystems Engineering in 2006 and her Ph.D. from Georgia Tech in Bioengineering in 2011 under the mentorship of Prof. Tom Barker. Dr. Brown was an American Heart Association Postdoctoral Fellow in the School of Chemistry and Biochemistry and the Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech under the joint mentorship of Prof. Barker and Prof. Andrew Lyon. Dr. Brown is currently a Research Scientist in the School of Chemistry and Biochemistry at Georgia Tech. Her research focuses on developing novel microgel-based materials for a variety of biomedical applications including augmentation of hemostasis, enhanced wound healing, evaluation and modulation of cellular mechanotransduction and development of biosynthetic constructs for regenerative medicine.

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132 Fluor Daniel Building (EIB) @ 1:30 PM
All are invited!