Meet the Faculty Candidate Poster Session

AIChE 2014 Atlanta, GA

Blake N. Johnson, Department of Mechanical and Aerospace Engineering, Princeton Institute for the Science and Technology of Materials, Princeton University, Princeton, NJ, USA

The development of a biofabrication method which offers the ability to precisely assemble biologically functional multi-component devices and materials could allow for both revolutionary fundamental biological discoveries using advanced *in vitro* models for tissue regeneration and could ultimately lead to new tissue engineering-based applications for treatment of disease and complex injury.

Along these lines, my postdoctoral research has been dedicated the development of novel three-dimensional (3D) bioprinting approaches for creating anatomically conformal nerve guidance channels capable of regenerating complex peripheral nerve injury. Additionally, the approach was adapted to develop complementary nervous system-on-chip models which remain highly faithful to the composition and structure of peripheral nerve tissue. A light scanning-based model acquisition technique known as 3D structured-light scanning was used to generate high resolution computer models of the sciatic nerve tibial branch which served as the template for the final 3D printed nerve guide. The bioprinting approach also facilitated incorporation of supporting physical and biochemical cues which included longitudinal guidance cues and gradients of neurotrophic factors. The selective regeneration of the sensory and motor nerve pathways bifurcating from mixed nerve was also examined by incorporating internal hydrogel matrix which contained guiding biochemical cues in the different pathways. In order to elucidate the critical factors affecting regeneration of the bifurcating mixed nerve injury, we have developed complementary nervous system-on-chip platforms for the studying the influence of surface topology and biochemical cue spatial distribution on various important factors critical to successful peripheral nerve regeneration, including the support and guidance of axonal growth and the migration of Schwann cells.

My PhD research was focused on the developing ultra-sensitive biosensor technology for real-time monitoring of protein-protein, DNA-DNA, and DNA-RNA interactions in complex backgrounds, such as circulating fluids and environmental settings. Specifically, the research involved the modeling of sensor physics, as well as the fabrication and characterization of piezoelectric-based hybrid mechanical and electrochemical label-free biosensors. Significant biosensing achievements included the label- and preparation-free detection of a class of important circulating biomarkers, known as microRNA, directly in human serum and the detection of toxin-producing cyanobacteria, also known as blue-green algae, in environmental source waters. In addition to biosensing applications, my research also developed means of using sensor-based approaches for modulating the surface binding energy of immobilized molecules and cells using electromechanical and electrochemical energy.

As a new faculty member, I would continue to develop novel lab-on-chip devices for neuroregenerative therapy in the peripheral nervous system (PNS) as well as attempt to expand towards solving problems targeting fundamental biological questions related to central nervous system regeneration and degradation. Using the nervous system-on-chip platforms, I would also plan to examine new approaches for sensor-based stimulation of neuroregenerative response, as such devices provide a controlled setting for examining cellular responses to mechanical, electrical, and drug stimuli.