Department of Biomedical Engineering
UNIVERSITY OF WISCONSIN–MADISON

Spring 2020 Seminar Series

Materials and additive manufacturing for seamless bioelectronic-tissue interfaces

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Remarkable advances in medicine and biology have been made possible with bioelectronics–devices that bridge and connect the worlds of living systems and electronics. Bioelectronics include wearable sensors for health monitoring, in vitro diagnostics, therapeutic implantable devices, and electrical stimulation for tissue engineering and regeneration. Despite their influence, bioelectronic devices are still limited by the fact that they are disparate and distinct from biology. The quality of the device-tissue interface is poor and diminishes with time; this is thought to be due to many factors including significant surgical trauma, an aggressive foreign body response, poor material compatibility with the biological milieu, as well as imprecise and distant connections between electronics and surrounding cells or tissues. Towards addressing these challenges, I will first present the use of slippery surfaces for mitigating the consequences of implanting bioelectronics into delicate tissues. I will demonstrate how liquid-infused elastomers reduce tissue deformation and tearing associated with the insertion of intracortical probes in rats. I will then present how, unlike typical electronic fabrication processes, additive manufacturing is compatible with biomaterials and cells. I will demonstrate that when "inks", processing methods, and scaffold structure are engineered appropriately, extrusion-based 3D printing affords patterned, viable, and functional cell networks, and I will discuss how this can be exploited in future bioelectronic devices. To conclude, I will briefly present my vision to continue tackling the pressing challenges of biointegration that bioelectronics face in expanding their clinical and scientific impacts. The Rutz Lab will engineer "electronic tissues" that merge electronics and biology using additive manufacturing and biomaterials approaches.

ABOUT the SPEAKER

Dr. Alexandra Rutz received her BS (2011) with High Distinction from the University of Illinois Urbana-Champaign, double majoring in Chemistry and Molecular and Cellular Biology. She received her MS (2014) and PhD (2016) degrees in Biomedical Engineering from Northwestern University (Chicago, IL) and was advised by Prof. Ramille Shah. Alexandra's doctoral thesis focused on engineering hydrogel bioinks for 3D printing tissues and organs. Alexandra is now a Postdoctoral Fellow at the University of Cambridge (Cambridge, United Kingdom) working in the Bioelectronics Laboratory led by Prof. George Malliaras. Here, her research has focused on studying and designing new materials for bioelectronic devices. Collectively, Alexandra's work has been funded by the National Science Foundation Graduate Research Fellowship, the Whitaker International Fellowship, and the European Commission's Marie Skłodowska-Curie Individual Fellowship, and she has been recognized with awards from MilliporeSigma, Baxter International Inc, and the Society for Biomaterials. Alexandra has also been the lead organizer of the first-ever Bioelectronics symposium at the Society for Biomaterials (2018, 2019) and is currently co-organizing the Whitaker International Neuroengineering Workshop to be held in Cambridge, UK in 2020.

Monday, February 17 at noon
1003 Engineering Centers (Tong Auditorium)