DEPARTMENT OF MECHANICAL & AEROSPACE ENGINEERING
WILLIAM MAXWELL REED SEMINAR SERIES

"Nanotechnology Enabled Biomaterials Engineering for Nervous System Repair"

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Abstract:
Nanoparticle carriers are especially attractive for drug and gene delivery due to their ability to protect sensitive active pharmaceutical ingredients (APIs), target them to tissues of interest, and tune API release rates. Inorganic, mesoporous nanoparticles, including porous silicon and mesoporous silica nanoparticles, offer several advantageous properties, including high surface area and pore volume for drug loading, ease of surface chemistry modifications, tunable nanoparticle size and pore diameters, and are biodegradable/biocompatible, making them attractive nanocarriers for drug deliver applications. These properties also make them especially useful in the incorporation of nanoparticles into biomaterial scaffolds to alter material properties, protect sensitive therapeutics during fabrication, and tailor drug release properties. The versatility that multiscale materials offer is an important feature that can be exploited in biomaterials engineering. Here, the ability of these materials to interface and improve outcomes in the nervous system is demonstrated in models of traumatic brain injury (TBI) and peripheral nerve transection injury. Using a nanomedicine approach, growth factors were delivered systemically to the brain following TBI to reduce secondary injury. API-loaded nanoparticles were incorporated into polymer and hydrogel scaffolds through spray nebulization and digital light projection 3D-printing approaches in order to enhance in vitro neurite extension and improve in vivo outcomes following sciatic nerve transection injury. In order to build on this work and move beyond bulk hydrogel design, the fundamental chemistries and material properties of multiscale microgels, which combine the beneficial properties of both microgels and mesoporous silica nanoparticles, were elucidated. Integrating nanoparticle design concepts into multiscale materials engineering holds great promise across many fields in engineering.

Speaker Bio:

Jonathan Zuidema is a Marie Skłodowska-Curie Actions Individual Fellow (No. 101067770) at the Mario Negri Institute for Pharmacological Research. Prior to this, he was a project scientist in the Department of Neuroscience and postdoctoral researcher in the Department of Chemistry and Biochemistry at the University of California San Diego. He received his BS from Michigan Technological University and his Ph.D. from Rensselaer Polytechnic Institute in Biomedical Engineering. His research is focused on multiscale materials engineering that combines nanotechnology, materials development, material property characterization, and material fabrication, including electrospinning/spray nebulization, batch emulsion, and additive manufacturing, applied to the nervous system. Currently, he is working to develop multiscale microgels containing mesoporous silica nanoparticles to improve the design of biomaterial scaffolds. He has published 29 peer-reviewed articles in high impact journals, including Advanced Materials, JACS, Advanced Functional Materials, ACS applied materials and interfaces, Biomaterials, and Acta Biomaterialia. He is an inventor of 3 patents pertaining to porous polymer scaffolds and polymer microfibers, and won the Zelda and David G. Gisser Top BME Thesis Research Award at Rensselaer Polytechnic Institute.

Date: Friday, January 26, 2024
Time: 3:00 PM EST
Place: Whitehall Classroom Building 110
Contact: Dr. Jonathan Wenk

Attendance open to all interested persons

College of Engineering

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