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SEMINAR SERIES

Wednesday, February 7th, 2024
Seminar Presentation: 11:00am – 12:00pm
SME room 248

"Engineering Medicine at Multiscale via Granular Hydrogels"

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Abstract: Successful translation of medical technologies from the benchtop to the bedside requires orchestrated efforts between engineers and clinicians. Clinicians often request platforms that rigorously and safely interface with biological systems at the molecular, cellular, and tissue levels. At the Bio-Soft Materials Laboratory (B-SMaL), we aim at addressing some of the quintessential challenges in translational biomaterials by developing colloidal systems based on the micro- and nanoengineering of abundant biopolymers. In this talk, I will first explain how the inherent structural limitations of bulk hydrogels, the most common platform for tissue engineering scaffolds, may be addressed by converting them to stimuli-responsive discrete building blocks that undergo on-demand assembly and form granular hydrogel scaffolds (GHS). Hinging on the unique structure-property relationships of protein-based GHS, I will then show how cell assembly and tissue formation are guided rapidly and hierarchically, which are otherwise non-trivial to achieve using the bulk hydrogel counterparts. Finally, I will discuss the fundamental challenges ahead of additive manufacturing of GHS, followed by the nanoengineering strategies that we have developed to enable the extrusion three-dimensional (3D) bioprinting of GHS with preserved porosity as a steppingstone in translating the GHS. Together, these platforms show the power of marrying granular hydrogels with medicine to leverage eminent, translational technologies for improving the quality of life.

Keywords: Granular hydrogels, microfluidics, in situ tissue engineering, hierarchical vascularization, 3D bioprinting, biopolymers

Biosketch: Dr. Amir Sheikhi is an Assistant Professor of Chemical Engineering and Biomedical Engineering (by courtesy) at The Pennsylvania State University (Penn State). In August 2019, he founded the **B**io-**S**oft **Ma**terials **L**aboratory (***B-SMaL***) to tackle some of the challenges of the 21st century in biomedicine and the environment by designing novel bio-based colloidal systems via micro- and nanoengineering techniques. Amir's lab consists of 13 graduate students, 2 postdocs, and more than 15 undergraduate researchers, funded by NIH (NHLBI R01, NINDS R01, NIBIB R56), ACS PRF DNI, The REMADE Institute (DOE), Meghan Rose Bradley Foundation, Center for Lignocellulose Structure and Formation (CLSF), Penn State Institutes of Energy and the Environment (IEE), Benkovic Research Initiative, etc. Amir's research has been featured in more than 70 publications, 50 seminars, and 15 patent applications with recognition by over 40 news media outlets. He is the recipient of several major awards, including the AIChE's 35 Under 35, 2022 ACS Unilever Award for Outstanding Young Investigator in Colloid & Surfactant Science, The John C. Chen Young Professional Leadership Scholarship, and The UNIFOR Global Research Fellowship. Recently, Amir was named as one of the 9 emerging leaders in Chemical and Biomedical Engineering worldwide, featured on the cover of the Inaugural "*Futures*" Issue of Bioengineering & Translational Medicine journal. Amir earned his Ph.D. in Chemical Engineering at McGill University and continued to complete two years of post-doctoral research on colloids and macromolecules at McGill Chemistry. Before joining Penn State, he was a postdoctoral fellow in Bioengineering at Harvard Medical School and UCLA, working with Ali Khademhosseini. Amir is an Associate Editor of Bioengineering & Translational Medicine journal and serves as an editorial board member of Biomaterials and Bioactive Materials.