Fall 2021 NANOFANS FORUM

"Bridging Biology & Nanotechnology"

NANOFANS WEBINAR ANNOUNCEMENT

On-chip Spheroid Growth under Pulsatile Pressure

Chengzhi Shi, Ph.D.
Assistant Professor
School of Mechanical Engineering
Georgia Institute of Technology
Atlanta, GA

Date: October 6, 2021 (Wednesday)
Time: 11:00 AM – 12:00 PM EDT

Abstract: Spheroids and organoids are self-organized, three-dimensional cell aggregates that have recently become an invaluable tool for researchers due to their enhanced capacity to mimic in vivo morphology. However, due to their lack of angiogenesis, as they grow beyond ~500 µm in diameter, nutrients and oxygen are unable to penetrate into the central region. Thus, a necrotic core forms within mature spheroids & organoids. This central core of dead cells caused by a lack of vascularization / perfusion inhibits true replication of in vivo systems and prevents reliable, uniform, and repeatable cultivation of organoids. In microfluidic devices, carefully controlled dynamic flow and pressure conditions can improve nutrient delivery and fluid penetration into spheroids, thereby reducing the prevalence of the necrotic core, augmenting the efficacy of drug/particle intake, and increasing differentiation uniformity in organoids generated from pluripotent stem cells. In this talk, I will present the effects of varied flow conditions on fluid penetration depth in HEK293 spheroids. A microfluidic channel is utilized to expose developing spheroids to an oscillatory flow pattern. Alexa Fluor 594 is used to quantify the fluid penetration of cell culture media into the spheroids. Additionally, genetically modified HEK spheroids which express fluorescent proteins in the presence of doxycycline are assessed to quantify the penetration depth of drug delivery into the spheroid. The results show a promising trend of improving penetration of nutrient and drug delivery into the spheroids. These results will go on to inform long-term studies that use microfluidics to not only enhance spheroid growth and particle delivery, but also to improve differentiation uniformity and reliability in organoid models. By optimizing microfluidics in spheroid and organoid culture protocols, these "organon-a-chip" devices will advance groundbreaking biological and medical research.

Bio: Dr. Chengzhi Shi is an Assistant Professor in the George W. Woodruff School of Mechanical Engineering at Georgia Institute of Technology. He is also a program faculty of Bioengineering, Parker H. Petit Institute for Bioengineering and Bioscience, and Wallace H. Coulter Department of Biomedical Engineering at Georgia Tech. Before joining Georgia Tech, Dr. Shi earned his Ph.D. degree from the University of California, Berkeley in 2018 and his M.S. and B.S. degrees from Shanghai Jiao Tong University in 2013 and 2010. His research interests include physical acoustics, wave propagation, metamaterials, ultrasound imaging, and therapeutic ultrasound. He has published many highly cited papers in prestigious journals including Science, PNAS, and Nature Communications. Dr. Shi's research is supported by the National Science Foundation.

Register to receive meeting URL: https://tinyurl.com/fall2021nanofansflyer