Centre for Biosystems Science and Engineering

S E M I N A R

at 04:00 PM on May 12, 2017
MRDG Seminar Hall

Biomaterials and Engineering Solutions to Stem Cell Biology

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Regenerative medicine is an emerging interdisciplinary field, which integrates a number of diverse fields including biology, materials and polymer science, physics, engineering, and medicine. In this talk, I will discuss our recent efforts in integrating engineering tools like microfabrication, microfluidics, and mathematical modeling with biomaterials to improve the outcome of stem cell-based therapies and to develop "organs/disease-on-chip" models. First, I will talk about the design of polymer-based scaffolds as artificial extracellular matrices to regulate various cellular behaviors necessary to promote wound healing, tissue repair, and reinstating the functionality of dysfunctional tissues/organs. In addition to assisting cell and tissue transplantation, such bioengineered scaffolds could be used as devices to activate host endogenous cells to promote tissue repair and as a technological platform to gain new mechanistic insights. I will also discuss how permanently cross-linked hydrogels can be engineered to exhibit self-healing in an aqueous environment, and also discuss possible biomedical applications of such hydrogels.

Next, I will talk about our efforts on understanding the role of physical properties of the matrix in disease progression such as cancer metastasis. Metastatic dissemination of cancer cells is a key contributor to >90% of cancer-related mortality. Though metastasis involves multiple steps, the ability of cancer cells to invade and traverse through dense 3D structures (i.e., extracellular matrix such as collagen network) is a crucial manifestation of cancer malignancy. In order to understand cancer cell invasion and migration, we have developed a single cell resolution quantitative assay to estimate the three-dimensional (3D) traction stresses generated by the cancer cells during their migration. We also examined the effect of material properties on protease independent vs. dependent mode of migration of cancer cells. Such quantitative analysis would lead to identification of new pathways that might be targeted to develop therapies to treat cancer metastasis. I will end by briefly introducing "organs-on-chip" technological platforms that we are developing to achieve physiologically relevant healthy- and disease-models to study basic concepts and screen drug and small molecules.

About the speaker:

Shyni Varghese, Ph.D., is a Professor of Bioengineering, with affiliations in NanoEngineering, Materials Science and Institute of Engineering in Medicine, at University of California, San Diego. Dr. Varghese's research focuses at the interface of biologically inspired materials and stem cells. Dr. Varghese has co-authored over 80 peer-reviewed research articles, covering a wide range of interdisciplinary topics in stem cells, smart biomaterials, biologically inspired systems, and regenerative medicine. Her research activities have also resulted in over 12 patent disclosures. Examples of ongoing research activities in her laboratory involve developing: functional biomaterials such as self-healing materials, technologies to improve stem cell based therapies including activating endogenous stem cells, engineered functional tissue grafts, and organ-on-a-chip systems. She is on the editorial board of a number of journals and a consultant to various biotech companies. She is currently serving as an associate editor of Biomaterials Science (an RSC journal).