Nano-and Microfabricated Hydrogels for Regenerative Engineering

Micro- and nanoscale technologies are emerging as powerful tools for controlling the interaction between cells and their surroundings for biological studies, tissue engineering, and cell-based screening. Hydrogel biomaterials have been increasingly used in various tissue engineering applications since they provide cells with a hydrated 3D microenvironment that mimics the native extracellular matrix. We have developed various approaches to merge microscale techniques with hydrogel biomaterials for directing stem cell differentiation and generating complex 3D tissues. In this talk, I will outline our work in controlling the cell-microenvironment interactions by using patterned hydrogels to direct the differentiation of stem cells; including the fabrication and the use of microscale hydrogels for tissue engineering by using a `bottom-up' and a `top-down' approach. Top-down approach for fabricating complex engineered tissues involves the use of miniaturization techniques to control cell-cell interactions or to recreate biomimetic microvascular networks within mesoscale hydrogels. Our group has also pioneered bottom-up approaches to generate tissues by the assembly of shape-controlled cell-laden microgels (i.e. tissue building blocks), that resemble functional tissue units. Microgels were fabricated and seeded with different cell types and induced to self-assemble to generate 3D tissue structures with controlled microarchitecture and cell-cell interactions.

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Ali Khademhosseini is Professor of Bioengineering, and Chemical and Biomolecular Engineering at UCLA Henry Samueli School of Engineering and Applied Science, and at the UCLA Radiological Sciences David Geffen School of Medicine. He is a director of the Center for Minimally Invasive Therapeutics (C-MIT) and an associate director for the California NanoSystems Institute at UCLA. He is recognized as a leader in combining micro- and nano-engineering approaches with advanced biomaterials for regenerative medicine applications. In particular, his laboratory has pioneered numerous technologies and materials for controlling the architecture and function of engineered vascularized tissues. He has authored ~550journal papers (H-index > 114, >47,000 citations) and 60 books/chapters. In addition, he has delivered 300+ invited/keynote lectures. Dr. Khademhosseini's interdisciplinary research has been recognized by over 40 major national and international awards. He is a recipient of the Presidential Early Career Award for Scientists and Engineers, the highest honor given by the US government for early career investigators. In 2011, he received the Pioneers of Miniaturization Prize from the Royal Society of Chemistry (RSC) for his contribution to microscale tissue engineering and microfluidics. In 2016, he received the Sr. Scientist Award of Tissue Engineering and Regenerative Medicine Society -Americas Chapter (TERMIS-AM), in 2017 he received the Clemson Award of the Society for Biomaterials and in 2018 he was honored by the Acta Biomaterialia Silver Medal (2018). He is also a fellow of the American Institute of Medical and Biological Engineering (AIMBE), Biomedical Engineering Society (BMES), Royal Society of Chemistry (RSC), Fellow of the Biomaterials Sciences and Engineering (FBSE) and American Association for the Advancement of Science (AAAS). Currently he serves on the editorial board of numerous leading journals as well as an Associate Editor for ACS Nano (IF: 13.3) and a member of NIH BTSS study section. He received his Ph.D. in bioengineering from MIT (2005), MASc in biomedical engineering (2001) and BASc in chemical engineering (1999) degrees from University of Toronto. Read more at http://www.tissueeng.net/.

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