Abstract

3D Polymer Structures for the Identification of Optimal Dimensions for Cellular Growth for 3D Lung Alveolar Models †

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Abstract: Organ-on-chips and scaffolds for tissue engineering are vital assay tools for pre-clinical testing and prediction of human response to drugs and toxins, while providing an ethically sound alternative to animal testing and a low-cost alternative to expensive clinical studies. An important success criterion for these models is the ability to have structural parameters for optimized performance. In this study we show how the two-photon polymerization fabrication method can be used to create 3D test platforms made for analyzing optimal scaffold parameters for cell growth. We design and fabricate a 3D grid structure, designed as a set of wall structures with niches of various dimensions for probing the optimal niche for cell attachment. The 3D grid structures are fabricated from bio-compatible polymer SZ2080 and subsequently seeded with A549 lung epithelia cells. The seeded structures are incubated and imaged with multi-color spectral confocal microscopy at several time points, to determine the volume of cell material present in the different niches of the grid structure. Spectral imaging with linear unmixing is used to separate the auto-fluorescence contribution from the scaffold from the fluorescence of the cells and use it to determine the volume of cell material present in the different sections of the grid structure. The variation in structural parameters influences the incubated A549 cells’ distribution and morphology. In future, this kind of differentiated 3D growth platform could be applied for optimized culture growth, cell differentiation and advanced cell therapies.

Keywords: two-photon polymerization; 3D cell scaffolds; spectral imaging; linear unmixing


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