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STEREOLITHOGRAPHIC 3D PRINTING OF HYDROGELS USING LIGHT-CONTROLLED RADICAL POLYMERIZATION

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Abstract

With the advent of 3D printing techniques, there has been ever increasing attention and efforts towards engineering 3D culture models that better mimic the *in vivo* cellular microenvironment compared to conventional 2D culture on a planar substrate[1]. On the other hand, hydrogel materials composed of crosslinked polymeric network are most commonly used in constructing 3D culture models due to their resemblance to native extracellular matrix (ECM)[2]. However, approaches that shape generally soft hydrogels into pre-defined geometries with required structural complexity and stability have remained limited.

Here, we report a stereolithographic high-resolution 3D printing technique utilizing poly(ethylene glycol) diacrylate with relatively low molecular weight (PEGDA, MW 700) to manufacture biocompatible, mechanically stable yet permeable hydrogel constructs with embedded perfusable channel network as well as culture volumes that can later be filled with cells encapsulated in matrix of choice. By optimizing our printing configurations (pre-polymer formulation, light exposure time, *etc.*), we have been able to print perfusable microchannels with a cross-section as small as 100 µm × 100 µm and the printed constructs can be steadily perfused up to one week. We believe this proposed strategy represents an automated, cost-effective and high resolution technique to fabricate complex 3D hydrogel constructs with useful applications such as in drug screening and toxicology.

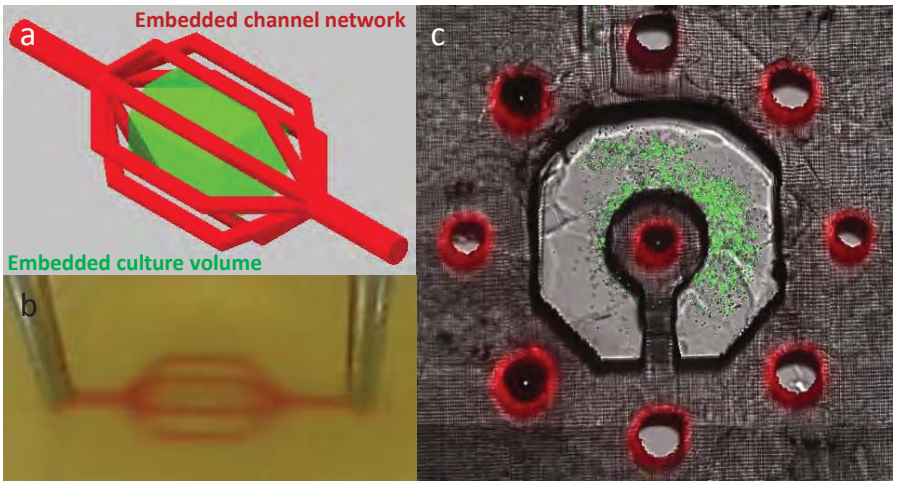

Figure: a) Schematic of a generic 3D cell culture model with embedded perfusion channel network (red) and culture volume (green). b) Printed PEGDA construct perfused with dyed liquid. c) Confocal fluorescence micrograph of a cross-sectioned slice of the construct showing the perfused channel network (rhodamine, red), live 3T3 fibroblasts (green) encapsulated in gelatin matrix and the PEGDA construct outline (transmitted light, gray).

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