

3D Heterogeneous Architectures Formation on an Electromicrofluidic Platform

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Manufacturing three-dimensional (3D) architectures through assembly of prepolymer hydrogel droplets with suspended cells/particles/molecules and crosslinked building blocks with reorganized embedded objects is demonstrated on an electromicrofluidic platform. The complex and heterogeneous 3D architectures are in great demand in various applications, including in the production of novel metamaterials with properties atypical or nonexistent in nature or in the construction of artificial tissues that recapitulate physiological functions by imitating biological structures. 3D hydrogel building blocks with reorganized cells or particles are formed and assembled on the electromicrofluidic platform adopting electrowetting and dielectrophoresis [1, 2]. We demonstrate the manipulations of varied objects (a) in multiple phases such as prepolymer liquid hydrogel droplets (PEGDA, poly(ethylene glycol) diacrylate or GelMA, gelatin methacryloyl) and crosslinked hydrogel building blocks, (b) on a wide range of scales from micrometer cells or particles to millimeter assembled hydrogel architectures, (c) with diverse properties such as conductive and dielectric prepolymer droplets that are photo, chemically, or thermally crosslinkable, and (d) in adjustable geometries including discrete droplets and continuous liquid columns. 3D hydrogel architectures, composed of varied particles or cells reorganized in programmable patterns and biomimetic hydrogels of designed properties and in adjustable geometries, are obtained. The electromicrofluidic platform is general and alternative to manipulate particles/cells and prepolymer solutions for reconfigurable 3D architectures.

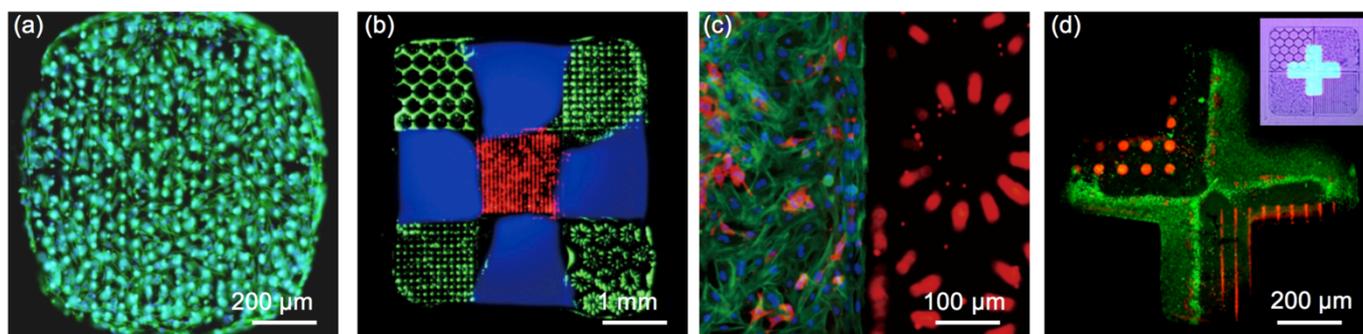


Figure 1 Constructing 3D building blocks and architectures on an electromicrofluidic platform. (a) A building block made of a GelMA hydrogel droplet and reorganized NIH 3T3 fibroblasts [1]. (b) An architecture with 3x3 assembled PEGDA droplets with fluorescent dye and particles [1]. (c) Neonatal mouse cardiomyocytes patterned on the surface of a hydrogel architecture consisting of GelMA and PEGDA [1]. (d) A PEGDA building block crosslinked by patterned light.

Reference:

- [1] M.-Y. Chiang, Y.-W. Hsu, H.-Y. Hsieh, S.-Y. Chen, S.-K. Fan, *Science Advances*, **2**, e1600964 (2016).
- [2] S. Takeuchi, *Nature*, **541**, 470-471 (2017).