Direct-Write Assembly of 3D Microperiodic Hydrogel Scaffolds for Human Embryonic Stem Cell Culture

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Key Research Aims and Goals

To develop a system for the culture and proliferation of human embryonic stem cells (hESCs) in a biocompatible, 3D environment as a closer mimic of biological systems compared to current 2D well plates.

Research Highlights and Results

- Development of a shear thinning hyaluronic acid gel that is compatible with the direct ink write fabrication system. The ink is UV curable through chemical modification and biocompatible. 3D scaffold feature sizes can be arbitrarily designed to fit project parameters.
- Initial cell studies with hESCs have shown the 3D hyaluronic acids scaffolds to be a promising system for proliferation of hESC cultures. Proliferation has continued for up to 14 days, with growth on scaffolds more pronounced than flat substrates.

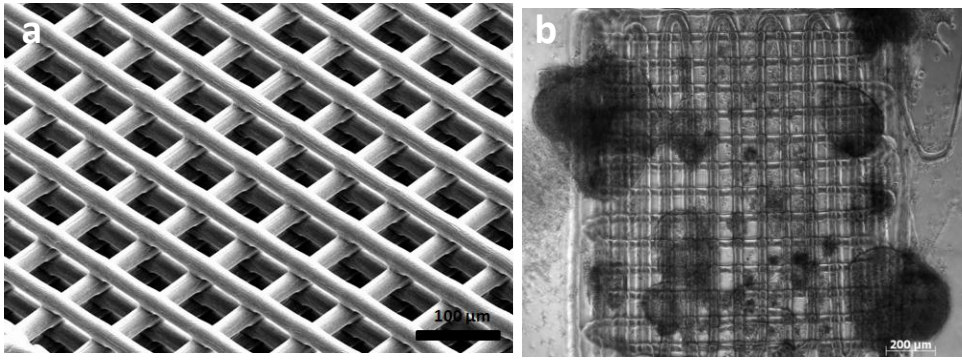

Fig 1 (a) Micrograph of cured hyaluronic scaffold with 30µm filament width and 6 total layers. (b) hESCs after 11 days in culture within a hyaluronic acid scaffold.

Future Research Plans

- The substrate stiffness which the hESCs are experiencing will be fully characterized. Through modification of the chemical synthesis, UV exposure intensity, and feature size, we will be able to examine cell responses to varying substrate stiffness and geometries.
- Expansion of the hyaluronic acid system to other cell types and differentiation pathways can push the technology into implantable designs. Current work with mesenchymal stem cells and chondrogenic repair is promising.
- Scaffolds are able to withstand a large degree of deformation before experiencing mechanical failure. Further exploration is warranted to investigate the possibility of injectable scaffolds systems.

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