



Office of Technology Management

Microfluidic Patterning of Cellular Biopolymer Matrices

Technology Reference

CW033

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Field

Cell Biology

Drug Discovery

Tissue Engineering

Key Words

3-D Matrix

Multilayer

Biomimetics

Microfluidics

Cell co-culture

Cell-cell interactions

License Status

Seeking licensing partner

Patent Status

Patent application filed

Overview

Cells in living tissues establish and maintain a well-organized hierarchical 3-dimensional architecture in which interactions between similar and different cell types play significant roles. Extracellular matrix proteins provide the natural scaffold upon which this architecture is built and also regulates processes such as cell motility, migration, differentiation and proliferation. The composition, density, and thickness of this matrix scaffold are all significant factors in determining the behavior of the cells. In current cell culture models, cells are grown in suspension or as adherent cultures on a solid support. Suspension culture largely suppresses cell-cell interactions while most adherent culture methods constrain these interactions to lie in the plane of the support. Neither method provides a realistic simulation of the in-vivo environment in which multiple cell types are arranged in and interact in a dynamic hierarchical 3-dimensional architecture. Differences in cellular characteristics such as motility, differentiation, proliferation and morphology between cells grown in suspension or on a support and those found in tissues are well known. This suggests that a cell culture method that more closely mimics in-vivo conditions will be beneficial in areas ranging from cell research and tissue engineering to drug discovery.

Technical Summary

This invention is a microfluidic system containing a three-dimensional configuration of multilayers of cells in biopolymer matrices. This invention creates a biomimetic system that simulates the in vivo architecture present in living organisms. In this system, layers of different cells are placed on one another in a biopolymer gel within a microfluidic channel, enabling the interaction among heterogeneous cells, proteins, and chemicals in different layers. The invention includes the method of producing the microfluidic system including (I) Modifying the surface of the substrate; (II) Microfabrication of PDMS microdevices; (III) Preparing various reconstituted biopolymer matrices; (IV) Contraction process of matrix cells; (VI) Multilayer patterning.

Benefits

- Method for biomimetics
- Method for cell microarrays
- Method for directed cell migration
- Microdevice for cell-based assays for drug screening
- 3-D patterning allows for multi-layering of different cells as opposed to 2-D monolayering
- Introduces biopolymer matrices in the microscale control on the surface
- In vitro model for studying the inflammatory process and healing response
- Method for generating functional bioartificial vessels/capillaries
- Can be coupled with imaging tools such as optical coherence tomography (OCT) for real time analysis in research

Areas of Application

- Cell/Tissue Research
- Cell Co-Culture
- Tissue Engineering
- Drug Discovery
- Biosensors

Stage of Development

- Proof of concept achieved