

Modular and Stackable Microfluidic Devices

Summary

Vanderbilt researchers have invented a modular microfluidic bioreactor that can be layered and stacked to create complex organ-on-chip systems that mimic the behavior of human organ systems such as the neurovascular unit. This modular device can also be assembled from separate, functioning bilayers, and at the end of a study disassembled for examination of individual cellular components.

Addressed Need

Organs-on-chips have great potential for use with drug discovery and the study of drug and toxin effects on organ function. However, serious limitations exist for current *in vitro* devices that test human physiology function, including the need to get disparate cellular components to function at the same time, and the difficulty in measuring critical parameters and imaging the cellular interactions. This technology overcomes these challenges and enables the cells to be cultured prior to assembly of the modular device. Furthermore, it is straightforward to disassemble the device and image or measure individual layers for cell or histological analysis.

Technology Description

This modular device includes multi-compartment, layered, and stackable microfluidic bioreactors that can be disassembled to enable long-term growth and monitoring of multiple human cell types in closely coupled compartments to mimic human organ behavior. The device performs well with low volumes and is able to measure the cellular bioenergetics in real time.

Unique Features

- ◇ Low-cost, modular, and stackable design
- ◇ The ability to construct stacking perfused layers using simple injection-molded components without the need for long, closed channels
- ◇ Real-time analysis of cellular interactions and high-content imaging
- ◇ Cells can be cultured in each individual layer prior to device assembly
- ◇ It is straightforward to disassemble and reconfigure the individual layers

Technology Development Status

Prototypes have been developed of various sub-components of the modular and stackable system. Further development is ongoing.

Intellectual Property Status

A patent application has been filed.

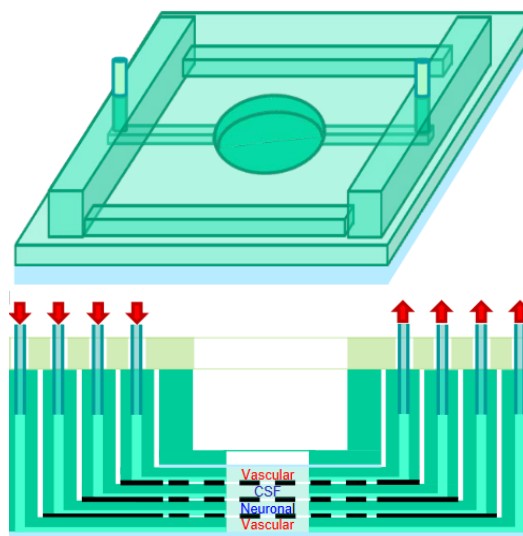


Figure 1: A schematic illustrating the modular and stackable microfluidic device developed for organ-on-chip studies.

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