

Low-cost, Normally Closed Microfluidic Valve

Summary

Vanderbilt researchers have developed a normally closed valve that is able to provide selective movement of small fluid quantities in a microfluidic device. The present microfluidic valve can be actuated using a simple rotating drivehead and mechanical support, greatly simplifying the valve design.

Addressed Need

Microfluidics is a rapidly growing field that enables exploration of both chemistry and biology using small sample quantities. However, the small sample size used in microfluidic devices places strict requirements on their accuracy and efficacy. Existing valves have serious limitations, including the need for continuous application of pneumatic pressure or electrical power to keep normally open valves closed for long periods of time, low switching speeds, dead space, unwanted fluid mixing when valves are being switched from open to closed, and cost. This invention addresses each of these concerns.

Technology Description

The novel microfluidic valve uses a series of fixed compression members that are raised and lowered via the rotating drivehead to control the open or closed position of a microfluidic channel. The unique design of this microfluidic mechanism also allows a hybrid design wherein one portion of the device can behave as a valve, while another channel behaves as a pump. The straightforward mechanical design and actuation of the microfluidic valve also reduce the overall cost of the device and create a highly adaptable and modular platform.

Unique Features

- ◇ Normally closed design requires no power to hold the valve shut
- ◇ Adaptable design allows for easy configuration of the device for specific applications, including making and breaking complex fluidic delivery and removal circuits
- ◇ Low-cost mechanical valve design can be actuated using a simple DC motor that dissipates no power to hold the valve open or closed
- ◇ Can enable a flush mode to rinse the common valve fluidics between fluid changes
- ◇ Can be implemented with single-lay injection-molding with materials other than PDMS

Technology Development Status

The valves have been prototyped and tested for use in various microfluidic and organ-on-a-chip devices. Advanced design-for-manufacture and testing are ongoing.

Intellectual Property Status

A patent application has been filed.

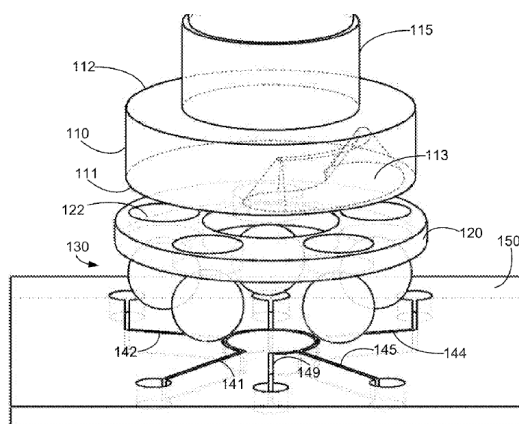


Fig. 1: An exploded view of the normally closed microfluidic valve.

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