

Pneumatic MEMS In-Channel Microvalves with In-Plane Control Ports for Micro Fluidic Systems Integrated on a Chip Surface

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In this paper, the concept, examples, and applications of pneumatic MEMS microvalves with in-channel structure and in-plane pneumatic control port for pneumatic actuation are introduced and discussed in detail. The important feature of this microvalve design is the combination of ‘in-channel’ inlet and outlet and ‘in-plane’ pneumatic transmission port for pneumatic actuation, which enables the microvalve to be positioned in various microfluidic systems on a chip surface. Pressure connections from the pressure chamber in horizontal direction are formed in the microvalve, which makes it possible to connect all the ports and the pressure control device with other fluidic channels or electronic circuits integrated on the same chip surface. Also, the separation between the pressure chamber and the drive microheater can be achieved in thermopneumatic microvalves using this pressure transmission path. This feature is effective to separate high-temperature regions from the channel region and becomes a great advantage for some kinds of micro-total-analysis-system (micro-TAS) devices with heat-sensitive samples.

In the article, the concept and features of this microvalve design are discussed first. Then, example microvalve devices with pneumatic and thermopneumatic actuators with an in-plane pressure control port based on the concept are introduced. Finally, novel applications in microfluidic systems with microvalve features integrated on the chip surface are discussed. Microvalves with high connectivity to fluidic channels and electronic devices on the same plane are a basic and important component in such applications.

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