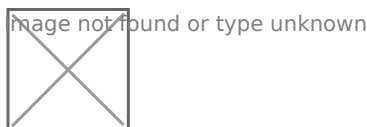


Thermoelectric valves for low-cost, energy efficient, portable microfluidics

Bioengineers in Prof. Stephen Quake's laboratory have developed an energy efficient, on-chip valve system for automated, multiplexed fluid control in a portable, low-cost microfluidics devices. Conventional microfluidics valves are pneumatically activated and require expensive, bulky, high-power off-chip equipment for liquid handling. This invention removes the pneumatic infrastructure and instead utilizes local thermal expansion to obstruct fluid channels through an automated on-chip heating element. The resulting valves demonstrate similar performance to pneumatic valves with three orders of magnitude less power consumption, lower cost, and no external equipment. The current prototype device (see below) fits in a pocket and runs on a battery.

The thermoelectric valves enable sophisticated automation for a range of liquid handling functions such as dispensing reagents, routing fluid flow, mixing and filtering. Microfluidics devices using these valves have a variety of end-user applications such as point-of-care diagnostics and nucleic acid sample preparation for DNA sequencing.



A prototype portable valve controller and chip. The chip is inserted into the card edge connector at the bottom of the image. Electronics enable automated chip control. A battery provides power. In this example, the entire device is mounted on the back of a mobile phone case to allow for imaging and control integrated with the existing phone architecture.

Stage of Research

The inventors have built a prototype.

Applications

- **Microfluidics valves** with end-user device applications such as:
 - point-of-care diagnostics
 - nucleic acid sample preparation systems
 - automated surveillance devices
 - food quality testing
 - monitoring of plant and livestock pathogens
 - in-field typing of organisms and agents
 - chemical analysis systems

Advantages

- **Low-cost, portable end-user devices:**
 - pocket-sized
 - eliminates off-chip elements (e.g., pressure source, pressure regulators, solenoid valves) needed for conventional pneumatic valves
- **Low power consumption:**
 - reduces power consumption by three orders of magnitude compared to existing valves
 - battery-operated
- **Automated, multiplexed fluid control** - valves can be independently addressed on-chip to enable a greater range of liquid handling capabilities than currently available with pneumatic control

Patents

- Issued: [10,527,193 \(USA\)](#)

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