Analytical Instrumentation, Methods & Materials


# Self-Regulating Microsystem that Integrates Silicon- and Polymer-Based MEMS Platforms

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**The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a self-regulating microsystem that combines the strengths of both silicon- and polymer-based MEMS platforms.**

## Overview

Silicon-based microelectromechanical systems (MEMS) work well for optical- and physical-sensing applications, and can be fabricated very precisely by using standard integrated circuit technology. However, silicon-based MEMS can't easily interface with liquid or organic systems because of the actuation methods (e.g., electrostatic methods) they tend to employ. Also, integrating microscale components (e.g., valves or pumps) into MEMS has proven time-consuming and expensive.

To address these limitations, polymer-based microsystems have recently been developed which use liquid-based photopolymerization to rapidly produce microcomponents *in situ* (inside microchannels).

## The Invention

UW-Madison researchers have developed an approach to fabricating microsystems that leverages the strengths of both silicon- and polymer-based MEMS platforms. Specifically, they have constructed and tested a self-regulating, temperature-controlled micromixer for creating flow within microchannels.

As in other MEMS, an externally-applied rotating magnetic field drives the mixer's rotation. But unlike traditional MEMS, which employ standard actuators, the micromixer is turned off and on by using temperature-sensitive hydrogel polymers.

When the fluid temperature inside a MEMS device rises above a certain temperature, a temperature-sensitive hydrogel ring surrounding the mixer's axel contracts, freeing the mixer to rotate under control of the magnetic field and pump fluid through the device to cool it. When the temperature cools sufficiently, the hydrogel ring expands and halts the mixer's rotation.

## Applications

- Temperature regulation within MEMS and microfluidic devices

## Key Benefits

- Provides a self-regulating approach to thermal management inside MEMS and microfluidic devices
- Eliminates the need for on-chip wiring because the microsystem is controlled only by environmental conditions
- Simple, rapid and inexpensive to manufacture
- Easily customized for different applications and environmental parameters
- Researchers have also developed a pH-controlled micromixer that stops mixing at high pH and rotates freely at low pH

## Additional Information

**For More Information About the Inventors**

- Hongrui Jiang
- David Beebe

**Tech Fields**

- Analytical Instrumentation, Methods & Materials : Microfluidics
- Engineering : Micro & nanotechnologies

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867