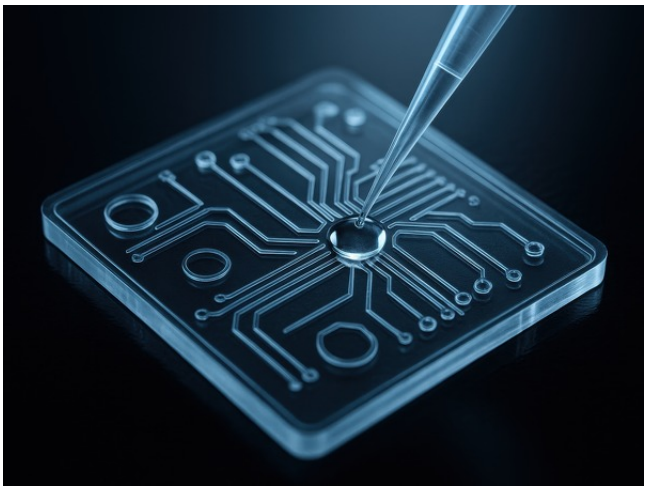
INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

MEMS Electrostatic Micro-Hydraulic Systems for Sensing and Actuation

TECHNOLOGY NUMBER: 5564



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Category
Hardware
Engineering & Physical Sciences
Semiconductor, MEMS, and Electronics

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OVERVIEW

Novel MEMS high-speed micro-hydraulics

- Reduces response time by 400× than previous designs in MEMS
- Microfluidic system control, tactile display manipulation, micro-airfoil use

BACKGROUND

Micro-electro-mechanical systems (MEMS) are crucial for high-precision tasks in microfluidic systems, tactile displays, and other applications requiring significant force and deflection. Traditional actuators like electromagnetic and piezoelectric methods face high power consumption or integration challenges, respectively. Macro-scale hydraulic systems, while effective, often do not translate well to the micro-scale, encountering issues such as external actuation reliance and problematic liquid encapsulation. Furthermore, existing micro-hydraulic systems suffer from slow response times, extensive cross-talk, and are not optimized for parallel micro-fabrication processes. This necessitates the development of more efficient and responsive micro-hydraulic systems in MEMS to support evolving technological demands.

INNOVATION

The proposed innovation introduces a new high-speed architecture for electrostatic micro-hydraulic systems, significantly improving response time while maintaining other specifications.

By employing a 2-D multi-physics model, a novel sloped-wall device design has been developed, yielding a time constant reduced by 400× compared to previous straight-wall designs. This technology has successfully been fabricated and tested, demonstrating a performance bandwidth of 50 to 70 Hz. Potential real-world applications of this innovation include high-resolution sensors with wide dynamic range and low power requirements, as well as actuators capable of significant out-of-plane displacement, useful in diverse fields such as microfluidic control, tactile display manipulation, and micro-airfoil adjustments.

ADDITIONAL INFORMATION

REFERENCES

"High-speed electrostatic micro-hydraulics for sensing and actuation"

INTELLECTUAL PROPERTY

US9502995 "Micro-hydraulic device"