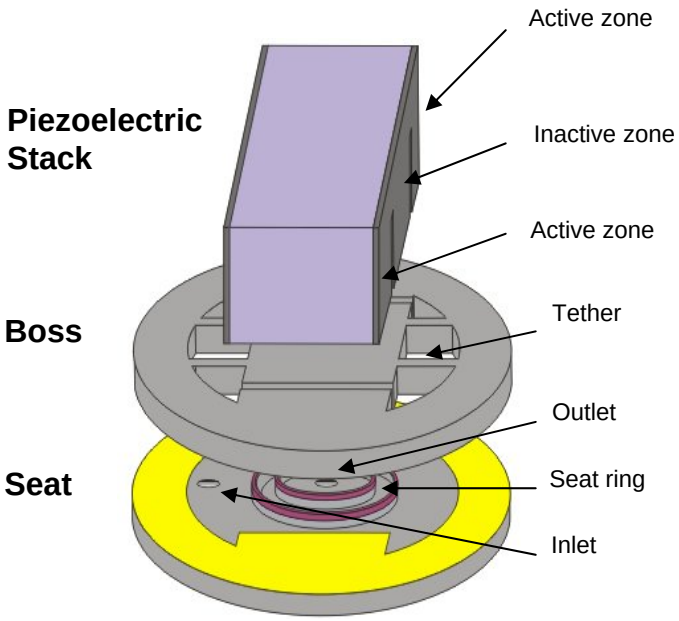
Technology Opportunity

National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

Piezoelectric MEMS Microvalves



Objective

Jet Propulsion Laboratory (JPL) is looking for U.S. companies to license and further develop its family of piezoelectric MEMS microvalve technologies.

Product Profile

JPL's family of piezoelectric microvalves is characterized by the following features:

- Piezoelectric actuator is separately constructed and then bonded to the rest of the valve body
- Normally closed operation
- Flow control effected by applying voltage to actuator
- Designs optimized for high-pressure operation
- Valve seat design with multiple concentric narrow seat rings allows high pressure operation with minimal leakage

Benefits

- Rapid response time (under 50 microseconds)
- Low-power operation
- Very low leak rate at high pressures

- Valve seat and boss design dramatically reduce blockage caused by particulates and resulting leakage

Potential Commercial Uses

- DNA analysis
- Miniature drug dosing systems
- Lab-on-a-chip and total micro-analysis
- Precision gas and chemical flow control for semiconductor manufacturing
- Precision dispensing
- Micro fuel cells
- Micro coolers for electronics

Technical Basics

JPL has developed a leak-tight piezoelectric microvalve that operates at extremely high upstream pressures for microspacecraft applications. The device is a normally closed microvalve assembled and fabricated primarily from micromachined silicon wafers. The microvalve consists of a custom-designed piezoelectric stack actuator bonded onto silicon valve components (such as the seat, boss, and tether). The entire assembly is contained within a stainless steel housing. The valve seat configurations include narrow-edge seating rings and tensile-stressed silicon tethers that enable the desired, normally closed, leak-tight operation. Leak testing of the microvalve, with a helium leak detector, showed leak rates of $5x10^{-3}$ sccm at 800 psi (5.516MPa). Dynamic microvalve operation (switching rates of up to 1 kHz) has been successfully demonstrated for inlet pressures in the range of zero ~ 1000 psi. The measured static flow rate for the microvalve under an applied potential of 10 V was 52 sccm at an inlet pressure of 300 psi. The measured power consumption, in the fully open state, was 3mW at an applied potential of 30 V. The measured dynamic power consumption was180 mW for 100 Hz continuous operation at 100 psi.

Technology Commercialization Status

JPL currently seeks to license its piezoelectric microvalve technologies to U.S. companies for commercial applications or to enter into collaborative agreements with U.S. companies to develop the technologies further.

Contact

If your company is interested in licensing opportunities or would like more information on JPL's piezoelectric MEMS microvalves, please contact:

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