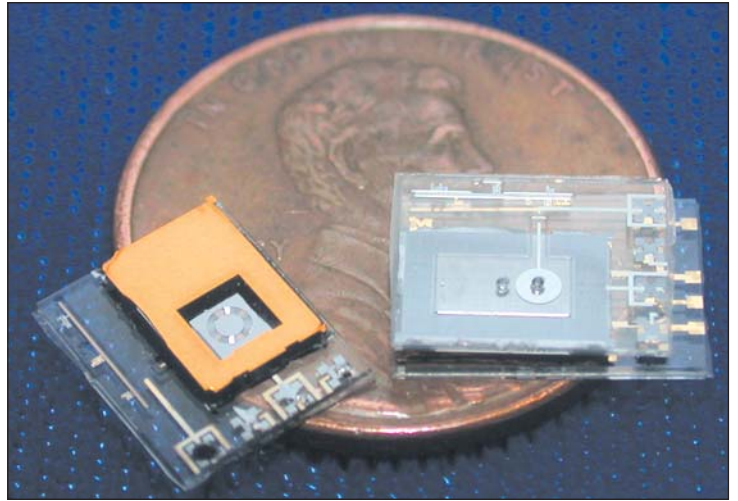


A Hybrid Thermo-Pneumatic and Electrostatic Microvalve With Closed-Loop Position Sensing

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The WIMS ERC has successfully fabricated a low-power, hybrid thermo-pneumatic and electrostatic microvalve that enables pressure programming of the WIMS micro gas chromatograph (μ GC) columns; it is believed to be the first device of its kind. To close the device, an elevated heater grid energizes a working fluid, raising the pressure in the cavity and deflecting a corrugated diaphragm and valve seat. The heater is suspended in order to increase its heating efficiency, and the corrugations serve to decrease the spring constant of the diaphragm, permitting valve travel greater than $35\mu\text{m}$. The capacitive pressure sensor reads out the cavity pressure and valve seat position and provides feedback to determine when to enable the electrostatic actuator. Once latched, the power to the heater can be reduced or eliminated. The $7.5\text{mm} \times 10.3\text{mm}$ valve has an open flow rate of 8sccm at 4.6Torr , a leak rate of $1.3 \times 10^{-3}\text{sccm}$ at 860Torr , an actuation time of 430ms , and a required hold power of 60mW while closed. In addition, to open the valve requires no power, whereas an energy of 108mJ is needed to close it. With minor improvements, the valve requires 35mJ to close in 140ms , a hold power of 6mW without the electrostatic latch, and no hold power with an electrostatic voltage of 180V . Lastly, it has a built-in position sensor with a sensitivity of 1.3fF/Torr . ■



The bottom (left) and top (right) of the hybrid microvalve.