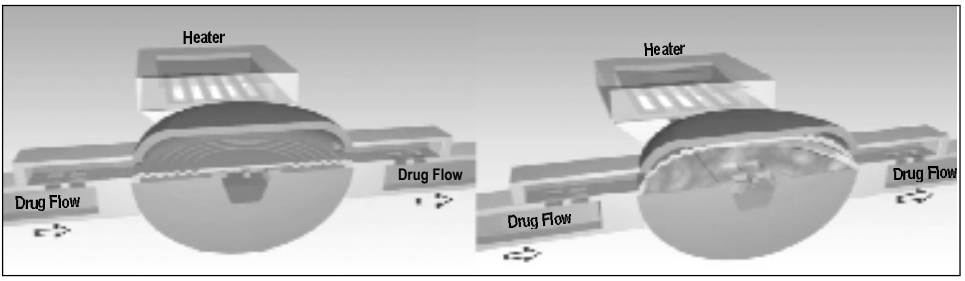
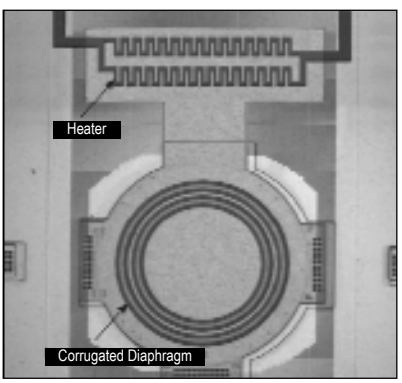
A Chronic Drug-Delivery Probe With Integrated Microvalves

Kyusuk Baek and Kensall D. Wise



A cross-sectional view of the Thermopneumatic Microvalve.

The recording sites of neural probes fabricated using thin-film technology make it possible to acquire 3-D images of electrical activity in the brain. The addition of a drug-delivery system will allow these images to be manipulated by delivering pharmaceuticals to the tissue on demand. The desired chemicals will be directed to the proper sites under the control of microvalves to allow multi-site, multi-chemical injection while minimizing the fluidic lead count. Finally, on-chip circuitry will be used to actuate the valves, control the drug delivery, and provide feedback to the system on the basis of the recorded action potentials. The actuator here uses phase-change, in which a low-boiling-point liquid is heated slightly beyond its boiling point, causing it to change from liquid to gas. The result is a huge volumetric expansion, which applies a large pressure to the valve plate. For a pneumatic valve, the measured open-flow-rate is 500pL/sec at 7.4kPa with a leak rate of 21pL/sec at an actuation pressure of 35kPa. Probes containing on-chip thermopneumatic valves are now being developed. This project is supported by the Engineering Research Centers Program of the National Science Foundation under award number EEC-9986866 and by a gift from Ms. Polly Anderson.



A top view of the Thermopneumatic Microvalve.