# A Low-Power Integrated Micromachined Gas Micropump

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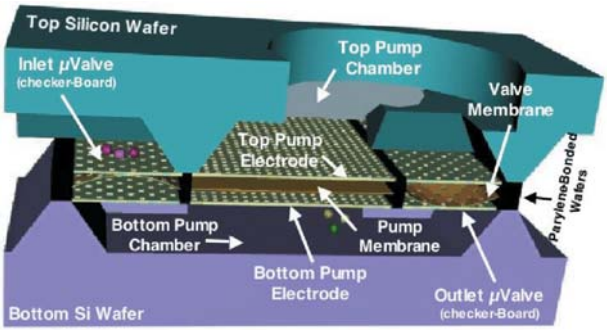
A four-stage peristaltic pump structure designed as proof-of-concept for a multistage (18-stage) gas micropump for use in a micro gas chromatography ($\mu$GC) system has been developed. The fabricated pump successfully integrates '*pull-pull*' dual electrostatic electrodes with small gap distance, active checkerboard microvalves, flexible polymer (Parylene) pumping membranes, and dual pumping chambers using two Parylene-bonded wafers. The dual electrodes allow the pump to be operated at high frequencies and the Parylene membrane provides large compliance to reduce operating voltage. The active part of the MEMS pump chip measures 0.8 x 0.5cm$^2$. The electrostatic micropump operates at 7kHz using a 100V drive voltage and produces an air flow rate of up to 2.4cc/min and generates up to 6900Pa of pressure. An 18-stage pump is currently in fabrication and is expected to increase the flow rate to 30cc/min and provide a pressure of 50kPa.




***Structure of the micropump. A thin Parylene membrane is sandwiched between two silicon wafers containing drive electrodes to form the pump membrane and two checkerboard valves.***

***Fabricated 4-stage pump, with and without the external fluidic port, next to a U.S. nickel.***