MICROFABRICATED GAS PUMPS FOR MICRO GAS CHROMATOGRAPHY AND OTHER APPLICATIONS

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This presentation will first review the trajectory of our efforts in developing lithographically microfabricated Knudsen pumps over the past two decades. These efforts have resulted in a spectrum of chip-scale Knudsen pumps. At one end of the spectrum is a 162-stage pump of 12x15 mm2 silicon footprint; this pump achieved a compression ratio from 760 Torr to 0.9 Torr. At the other end of the spectrum are silicon micropumps achieving 1-200 ml/min flow rate near atmospheric pressure. The presentation will then focus on application specific needs in the context of chemical sensing. Volatile organic compounds (VOCs) such as benzene, toluene, and xylene are common pollutants found in fugitive emissions from industrial processing; from refinement, distribution, and combustion of petroleum and oil; and from printing and painting. Elevated and enduring exposure to such VOCs can result in central nervous system dysfunction, respiratory and cardiovascular diseases, and cancer, and consequently there is a need for low cost equipment to monitor and regulate such emissions. The presentation will review some of our recent efforts to develop Knudsen pumps that can be incorporated into micro-gas chromatographs intended for identifying and quantifying VOCs. It will review architectural options and performance targets that should be considered when developing Knudsen pumps for this application, and the kind of VOC sensing that can be achieved when such pumps are used.

This research is performed in the context of the University of Michigan Center for Wireless Integrated MicroSensing and Systems (WIMS2). The Center brings together research in multiple specialties to facilitate microsystems for healthcare and environmental monitoring.