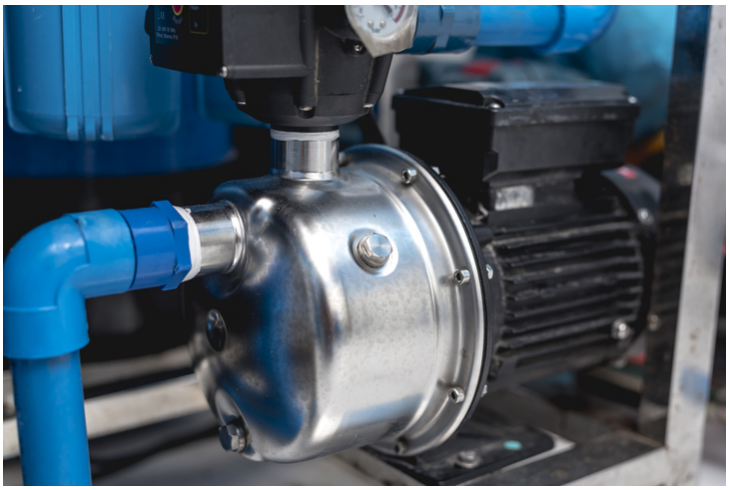
INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

# Modular Stacked Variable-Compression Micropump and Method of Making Same

**TECHNOLOGY NUMBER: 6718**



### Technology ID
6718

### Category
Hardware
Engineering & Physical Sciences
Semiconductors, MEMS, and Electronics

### Inventor
Ali Besharatian
Khalil Najafi
Luis Bernal
Seyed Amin Sandoughsaz Zardini

### Further information
Joohee Kim
jooheek@umich.edu

View online

## OVERVIEW

Modular stacked micropump for efficient, variable-compression gas pumping

- Enhances customization and efficiency by modifying stages post-fabrication
- Gas sensors, micro gas chromatography, breath analyzers, and environmental monitoring

## BACKGROUND

Gas micropumps play an essential role in portable and compact systems such as environmental monitors, health diagnostic devices, and miniaturized sensors. Historically, pumps utilized a planar design with multiple stages set during fabrication, limiting adaptability and efficiency for varying pressure and flow requirements. This rigidity often led to suboptimal performance, as each application had different needs for pressure and flow. Furthermore, the need for bidirectional movement of pump membranes added complexity and reduced efficiency. Existing designs struggled with effectively managing variations in gas densities and pressures across stages, often leading to reduced yield and increased power consumption. An improved micropump design is needed to accommodate varying requirements and enhance performance, enabling broader application across industries needing dynamic pressure and flow control systems.

## INNOVATION

Researchers at the University of Michigan have developed modular stacked variable-compression ratio multi-stage gas micropump with significant advancements in miniaturized gas pumping technology. By using stacked unit cells with adjustable volume ratios, this new design allows for post-fabrication customizability, enabling each stage to effectively manage different pressure levels without sacrificing efficiency. The use of dual membrane compression and decompression enhances performance without requiring bidirectional membrane movement, favoring efficient electrostatic actuation. This innovation results in a 3-stage pump that achieves a pressure difference of 1.1 kPa with an air flow rate of 85 µL/min. Real-world applications include compact and efficient gas chromatography systems, breath analyzers, and lab-on-chip devices that benefit from adaptable and efficient gas handling. The new design's capability for off-resonance operation further broadens its utility in diverse environments, supporting advancements in portable diagnostic and monitoring technologies.

## ADDITIONAL INFORMATION

REFERENCES

A. Sandoughsaz, A. Besharatian, L. P. Bernal and K. Najafi, "Modular stacked variable-compression ratio multi-stage gas micropump," 2015 Transducers - 2015 18th International Conference on Solid-State Sensors, Actuators and Microsystems (TRANSDUCERS), Anchorage, AK, USA, 2015, pp. 704-707, doi: 10.1109/TRANSDUCERS.2015.7181020

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