



A POTASSIUM ELECTRET ENERGY HARVESTER FOR 3D-STACK ASSEMBLY

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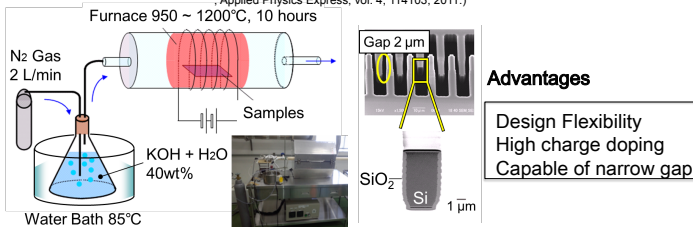
Abstract

We report an electrostatic energy harvester based on the potassium ion (K⁺) electret that could be stacked up into a 3D structure to multiply the output power. Vertical comb electrodes are implemented in a silicon-on-insulator (SOI) wafer with a relatively heavy mass in the handle layer to lower the resonance. A single substrate formation exhibited a 0.34 μW output at 310 Hz for a load resistance of 1 MΩ.

Introduction

Potassium Ion Electret

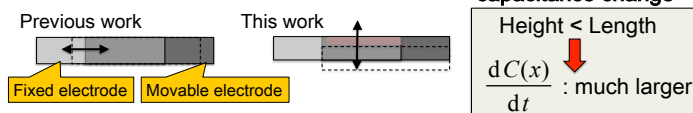
(T. Sugiyama, et al., "SiO₂ Electret Generated by Potassium Ions on a Comb-Drive Actuator" Applied Physics Express, vol. 4, 114103, 2011.)



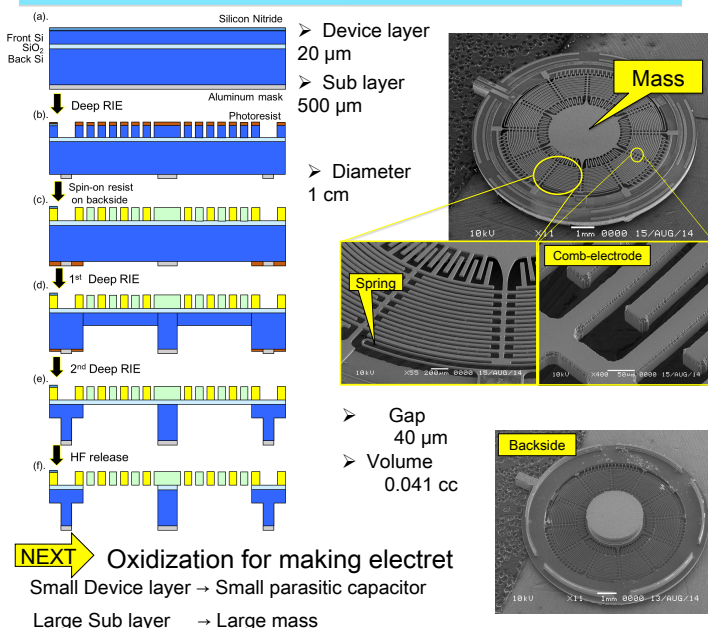
Objectives for this design

- High efficiency :
 - Higher Electro-mechanical conversion factor
 - No limitation of displacement of mass
- Narrow gap : **monolithic fabrication**
- High power : devices can be stacked

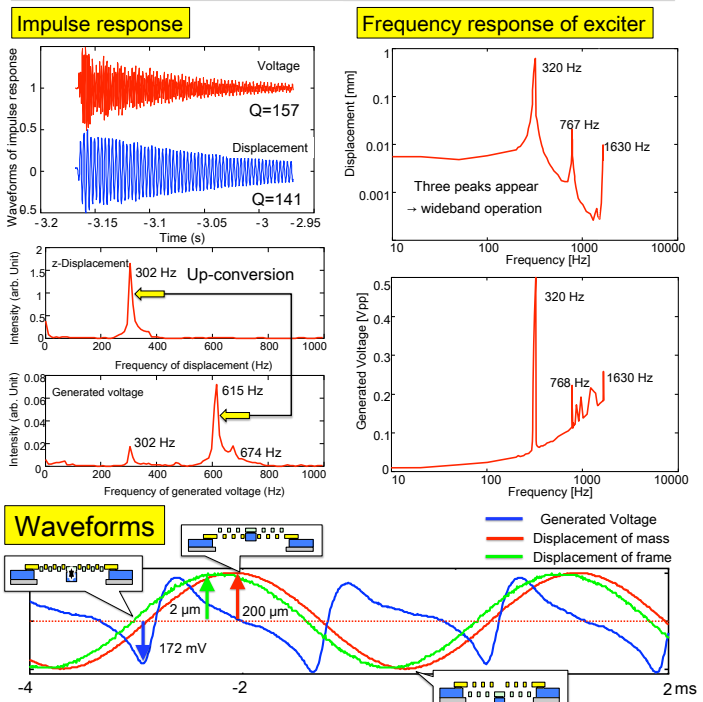
Movement mechanism



Process

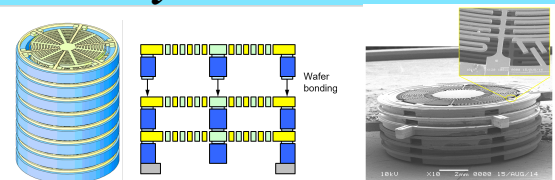


Result



Large amplitude → high velocity
 Peak inertial acceleration = 0.19 m/s² ~ vibration from Refrigerator
 Harvester effectiveness $EH = \frac{\text{Useful Power Output}}{\frac{1}{2} Y_0 Z_1 \omega^3 m} = 0.1 \%$

3D assembly



1. Voltage or current is multiplied by the number of stacked devices
2. For mechanical connection, glue is used for vibrating the masses at the same phase

Conclusion

A single substrate formation showed an output voltage of 0.3 Vpp at a resonant frequency of 310 Hz for a load resistance of 1 MΩ.

Typical output power at this condition was 0.34 μW.

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