Low-Frequency Vibration Energy Harvesting

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Vision

Ubiquitous wireless sensor networks have extraordinary potential for use in applications such as demand response, environmental monitoring, manufacturing & medical devices. Realization of these networks for wide-spread market use requires that the sensor nodes be low-cost, non-intrusive, & maintenance free. A microscale energy harvester addresses these needs by harnessing environmental vibrations to provide a replenishable source of power for the sensor node while simultaneously reducing the volume occupied by the power generator & the amount of raw materials required.

Research Questions

- Can a low ω_n device be fabricated using MEMS processes?
- Can energy harvesting & storage devices be integrated?
- Can ambient vibrations produce voltage output from MEMS energy harvester?

Methods

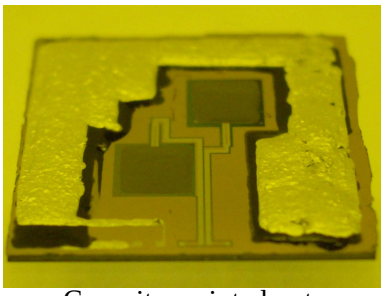
- Redesign & fabricate harvester to achieve low frequency resonance & reduce curvature
- Physically integrate harvester & capacitor
- Collect data from ambient vibration sources

Next Steps

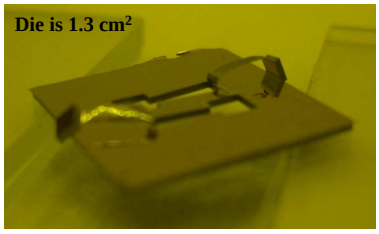
- Electrical & mechanical characterization
- Test on additional ambient sources
- Electrically connect harvester & capacitor
- Design next generation for robustness

Findings

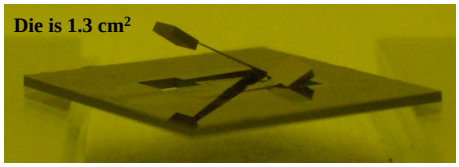
- Harvesters with resonance ~31 Hz were fabricated without curvature.
- Voltage output was obtained from device mounted on duct
- Capacitor was successfully printed on harvester substrate



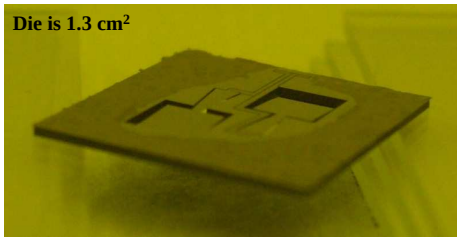
Capacitor printed onto energy harvester die.



Redesigned harvester, no Si layer under beam



Redesigned harvester, < ¼ μm Si layer under beam



Redesigned harvester, ~ ½ μm Si layer under beam

Voltage output signal from energy harvester when mounted on HVAC duct