

Charging Behaviour of Vibration And Wind Energy Harvesters Based On Free-standing Piezoelectric Thick-films



Yang Bai¹, Carl Meggs¹, Tim W Button^{1,2}

¹ Metallurgy & Materials, University of Birmingham, Birmingham, United Kingdom

² Central European Institute of Technology, Brno, Czech Republic



Introduction

Having experienced more than 20 years' research, Piezoelectric Energy Harvesting has shown to be a promising technology, and is predicted to approach commercialisation in several years. In order to evaluate the feasibility and explore potential applications, this poster presents the charging behaviour of vibration and wind energy harvesters based on integrated free-standing thick-film piezoelectric cantilevers, in which individual elements have been investigated and developed by the authors at earlier stages of the project.

Vibration Harvester - Individual

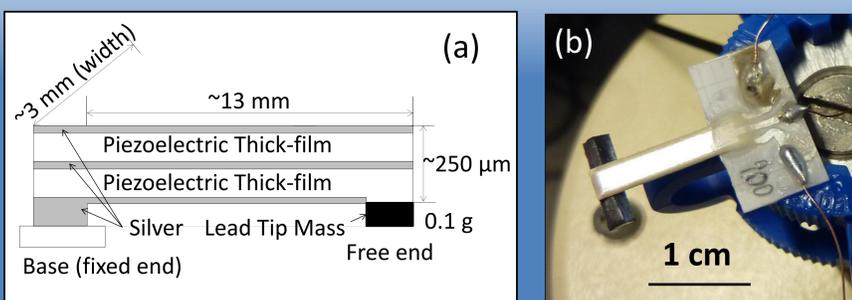


Figure 1. Proposed individual energy harvester with free-standing thick-film structure: (a) schematic of the construction; (b) the fabricated harvester.

Charging 1000 μF Capacitor - Individual

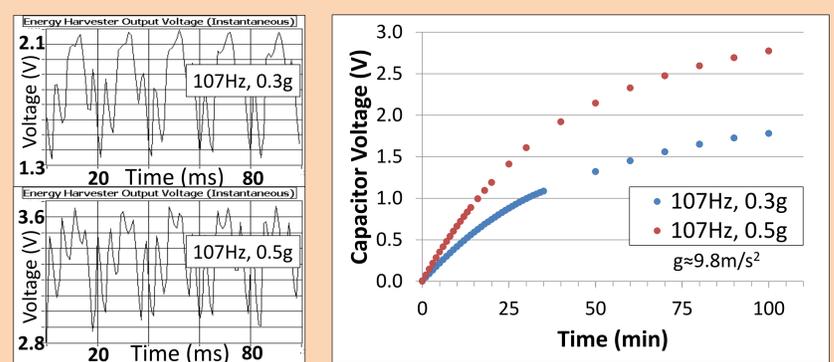


Figure 4. Instantaneous output voltage and charging response of an individual harvester.

Vibration Harvester - Array

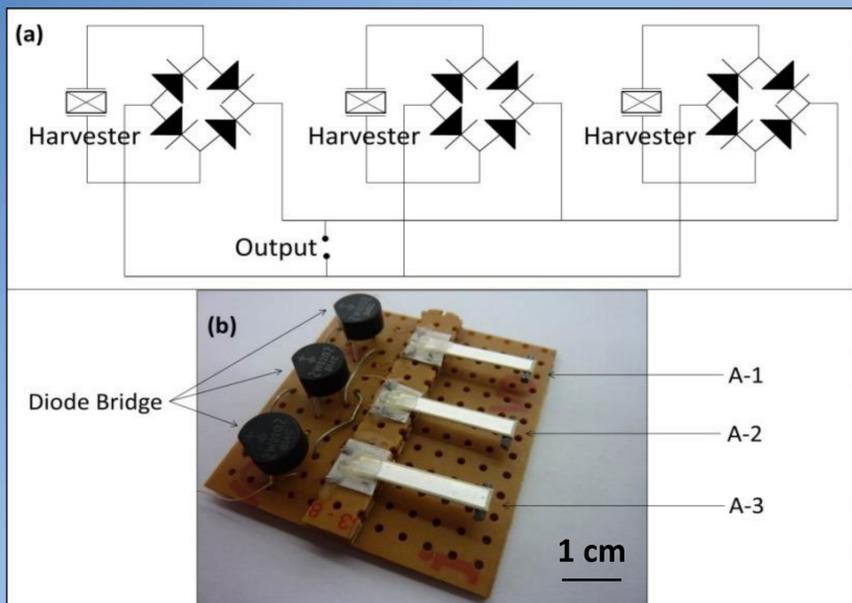


Figure 2. (a) The schematic of the connection method (b) the picture of an array.

Table 1. Summary of the dimensions, tip masses and frequencies of the array.

Single-element Harvester No.	Free-standing Length (mm)	Width (mm)	Layer Thicknesses (μm) (top Ag/Pt/Ag/Pb/bottom Ag)	Tip Mass (g)	Designed Frequency (Hz)
A-1	16.00	3.50		0.095	110
A-2	16.10	3.50	18.6/76.0/17.0/67.3/19.0	0.106	104
A-3	16.00	3.50		0.074	123

Charging 1000 μF Capacitor - Array

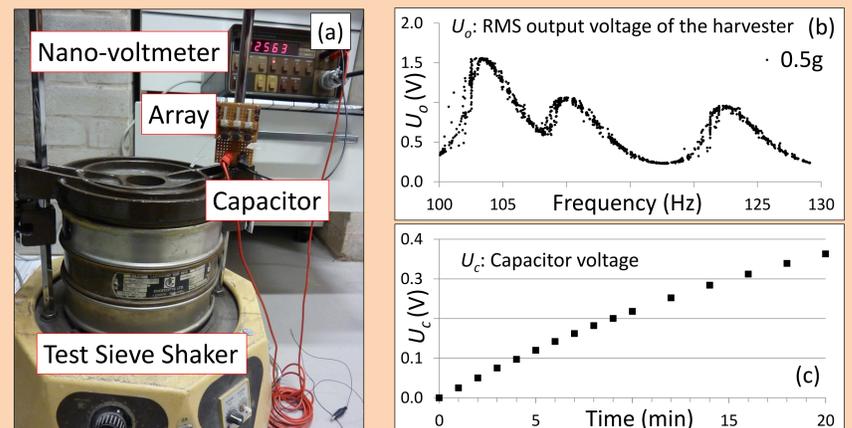


Figure 5. (a) Test configuration, (b) harmonic output and (c) charging response of an array mounted on a sieve shaker.

Charging 1000 μF Capacitor - Wind

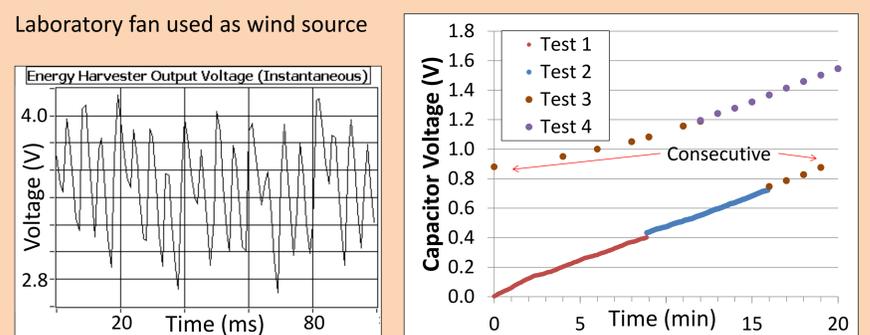


Figure 6. Instantaneous output voltage and charging response of a wind harvester in a series of four consecutive tests.

Wind Harvester Based on Piezoelectrics

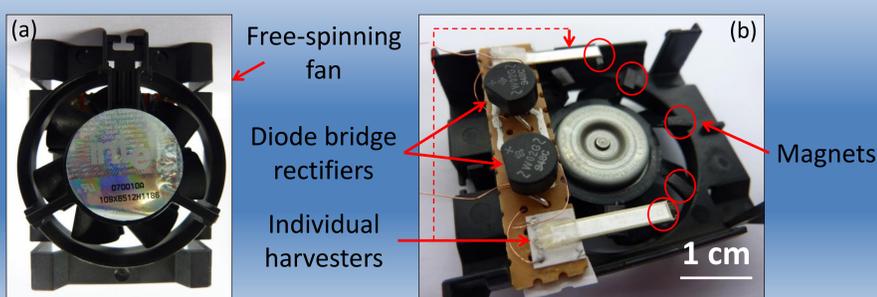


Figure 3. Pictures of wind harvester incorporating piezoelectrics: (a) front-side; (b) back-side

Summary

- Vibration harvesters have been able to charge a 1000 μF capacitor, under both harmonic and machinery vibration.
- Proposed structure has also been proved feasible to incorporate to a wind system, showing comparable output voltage and charging rate to those of the vibration systems.