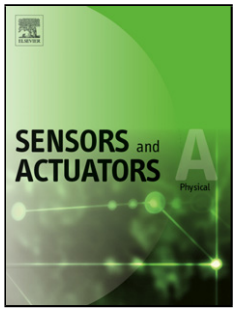

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PII: S0924-4247(18)30680-0
DOI: https://doi.org/10.1016/j.sna.2018.09.051
Reference: SNA 11026

To appear in: *Sensors and Actuators A*

Received date: 22-4-2018
Revised date: 16-8-2018
Accepted date: 21-9-2018

Please cite this article as: Haim Y, Marciano Y, deBotton G, Tunable direct beta-radiation harvester at the nanowatt scale, *Sensors and amp; Actuators: A. Physical* (2018), https://doi.org/10.1016/j.sna.2018.09.051

Tunable direct beta-radiation harvester at the nanowatt scale

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Highlights

- Direct β -radiation energy-harvesting from a $_{63}$Ni is experimentally investigated.
- This technique is interesting toward a reliable long-term miniature battery.
- The design, development and experimental evaluation of the harvester are presented.
- Steady state harvesting at a rate of 22.5 nW from 340 nW source was demonstrated.
- The resulting relations are in agreement with theory.

ABSTRACT

The feasibility of high efficiency direct energy-harvesting from a beta-current source is experimentally investigated by application of a dedicated apparatus. The idea is to collect the beta particles emitting from the source and convert these into usable electrical energy without intermediate steps. To this end an adjustable apparatus was designed and constructed, enabling to demonstrate, characterize and tune the rate of energy conversion under the constraints of small current (in the range of pA) and electric potential of up to 3800 V. At the center of the apparatus is a pair of moveable electrodes in which the beta-source is adhered to the positive one, and the emitted particles are collected on the opposite negative electrode. The energy conversion rate is controlled by adjusting the gap between the electrodes and the ultra-high resistance load circuit. Experimental setup, calibration curves and results are presented for a 15 mCi ^{63}Ni radioisotope. Energy harvesting rates of 22.5 nW achieved in the experiments correspond to a 6.6% efficiency of the process.