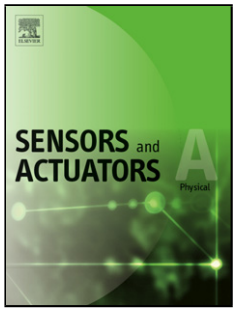

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A flexible, sandwich structure piezoelectric energy harvester using PIN-PMN-PT/epoxy 2-2 composite flake for wearable application

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Highlights

- The PIMNT/epoxy 2-2 composite flake is prepared by a novel non-transfer process.
- The stripe electrodes overlapping IDEs make the composite flake well polarized.
- The device can endure a small bending radius of 2.2 cm due to the sandwich structure.
- Bulk PIMNT crystal contributes to high output of the device (54.2 V/105 μW).
- The wearable device harvests biomechanical energy of knees motion successfully.

Abstract

Unlike the nano-generators whose piezoelectric materials in forms of particles, fibers and thin film, we present a sandwich structure flexible energy harvester using a high performance bulk form PIMNT/epoxy 2-2 composite flake (epoxy volume ratio of 20%). The device consists of a polyethylene terephthalate (PET) substrate, a PIN-PMN-PT single crystal/epoxy 2-2 composite flake (a thickness of 50 mm), an interdigital electrodes (IDEs) film and a PET cover, which is flexible enough to harvest energy from large deformation biomechanical movements. A theoretical analysis shows that the sandwich structure with composite in the middle layer contributes to the flexibility of the device and high performance bulk PIN-PMN-PT results in its high electrical output. Electrical properties of the device under different strains (bending radius), strain rates, electrode gaps and load resistances are studied systematically. Experimental results show that the device can withstand a small bending radius of 2.2 cm, where an open-circuit of 54.2 V and extrapolation current of 6.7 μA were acquired across a device area of 480 mm^2. The instantaneous power reach as high as 105 μW and can maintain its performance after 40000 bending-unbending cycles. We have also used