Electronic supplementary information for:

Self-powered Deep Brain Stimulation via a Flexible PIMNT Energy Harvester

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Other Supplementary Information for this manuscript
Video S1 - S2

Calculation for the bending stiffness of flexible PIMNT harvester
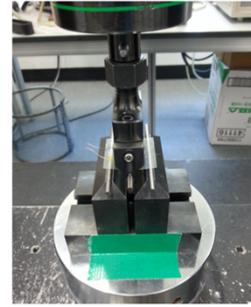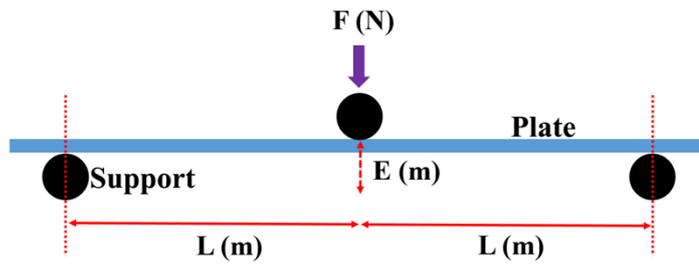
The bending stiffness (S_b) of a plate can be calculated as below equation at the three-point test configuration.[1]

$$S_b = F \cdot L^3 / 48 \cdot W \cdot E$$

where F is the applied force (N) on the plate center, L is the half of plate span (mm), W is the width (mm) of plate, and E is the vertical deflection (mm) of plate center. For the flexible PIMNT energy harvester (10 μm PIMNT on 125 μm PET substrate), bare PET film (thickness in 125 μm), and PIMNT on silicon wafer (total thickness in 700 μm), the L and W were 15 mm and 40 mm, respectively. The measured F and E by three-point test, and calculated S_b were shown in the below graphs.
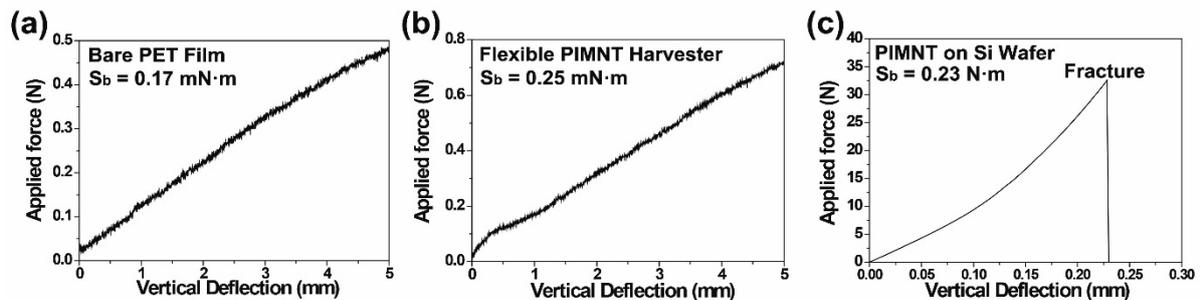
Fig. S1. Measured the relationship between applied force and vertical deflection from the three-point test, and calculated Sb for a bare PET film (a), a flexible PIMNT Harvester (b), and a PIMNT film on a silicon wafer (c). The flexibility of Flexible PIMNT energy harvester is similar to the bare PET film.

Reference 1: RE Mark, J Borch, *Handbook of physical testing of paper,* CRC Press, 2001.
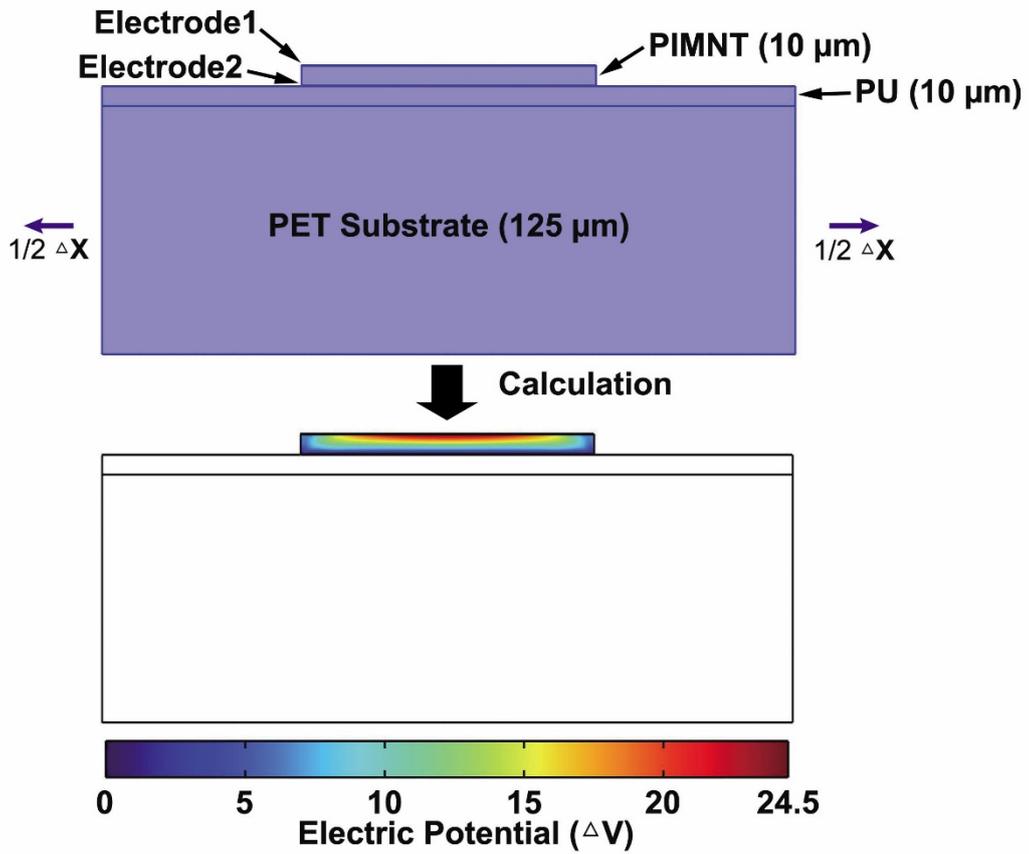
Fig. S2. Theoretical simulation model of PIMNT energy harvester (top) and piezopotential distribution of piezoelectric thin film (bottom) under in-plane tensile strain of 0.3 % in the length of PET substrate.
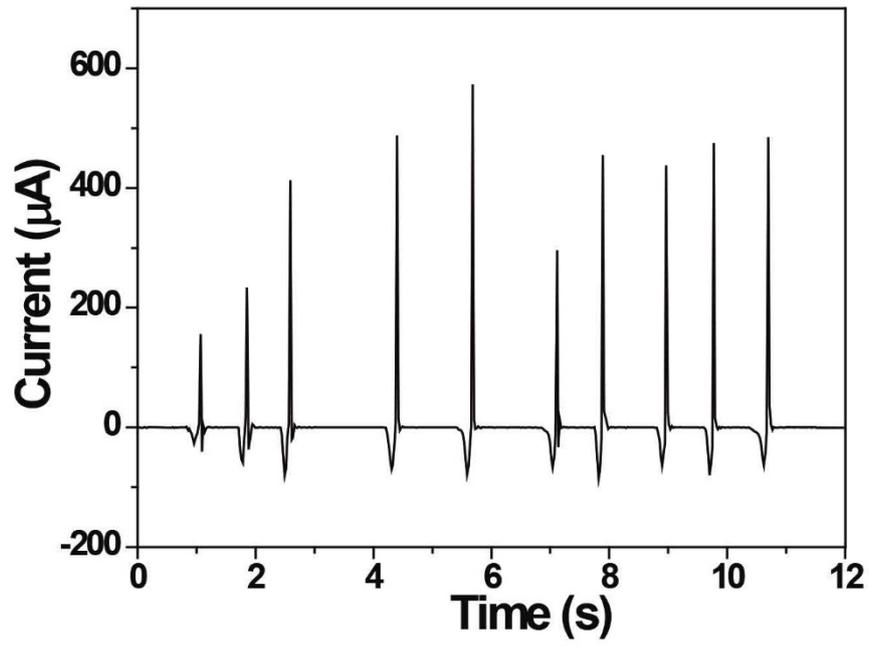
Fig. S3. Short-circuit output current peaks generated from the flexible PIMNT harvester bending by human fingers.
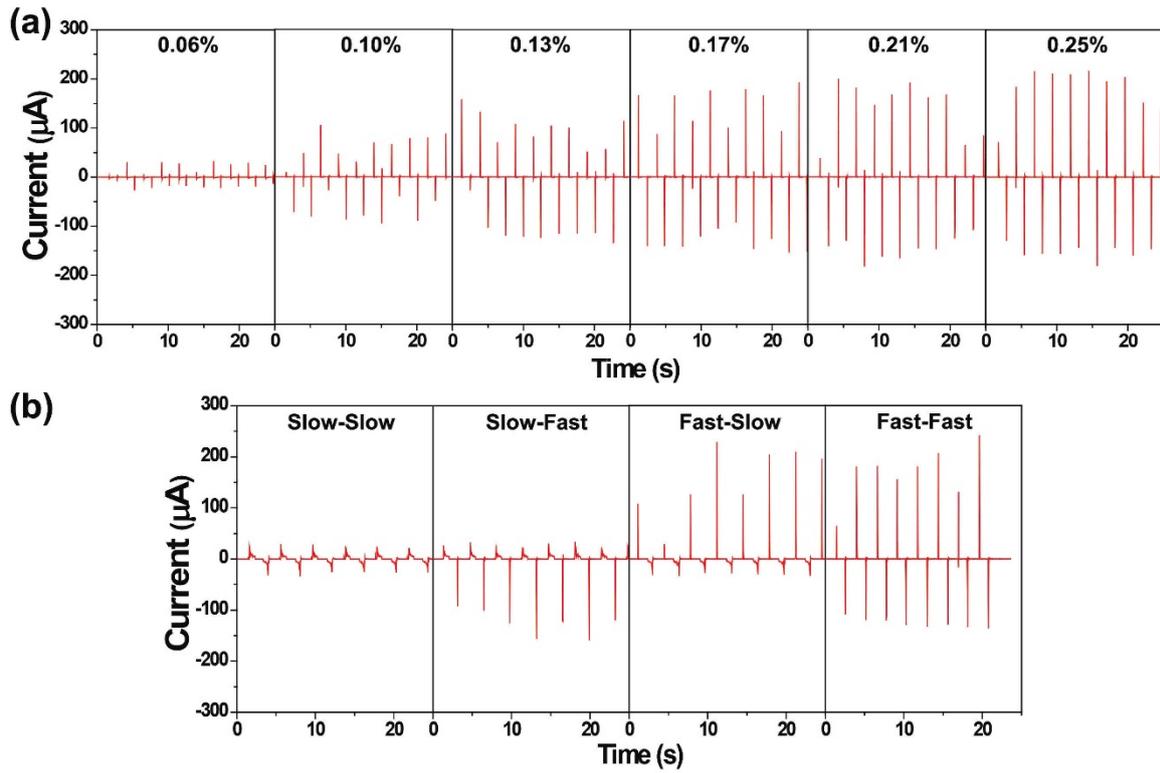
Fig. S4. (a) The output current measurement of the flexible PIMNT harvesting device with strain from 0.06 % to 0.25 %. (b) The output current signal generated from the harvester by different bending rate motions.
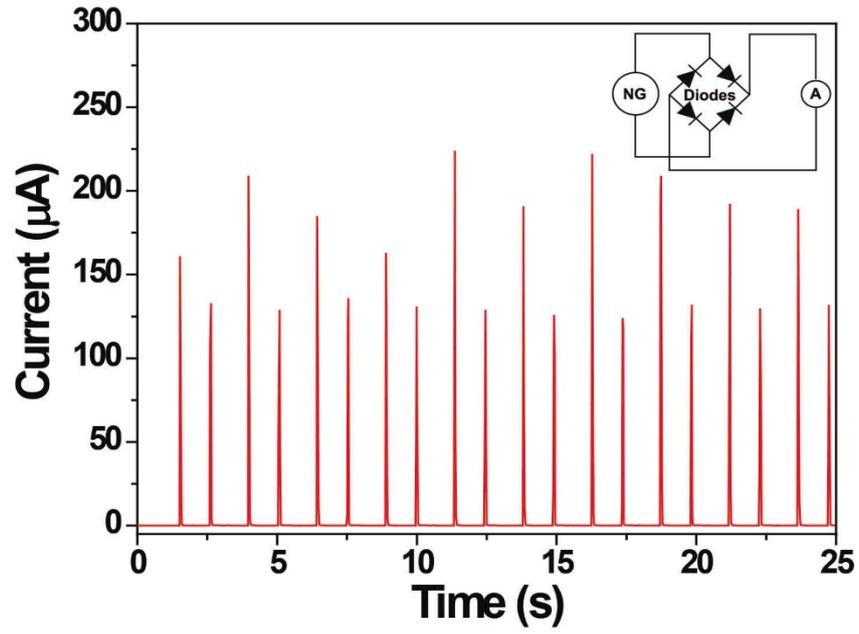
Fig. S5. The output current of the flexible PIMNT energy harvester after full-wave-bridge rectification by commercial four diodes. The inset shows schematic circuit diagram of the rectifying circuit system.
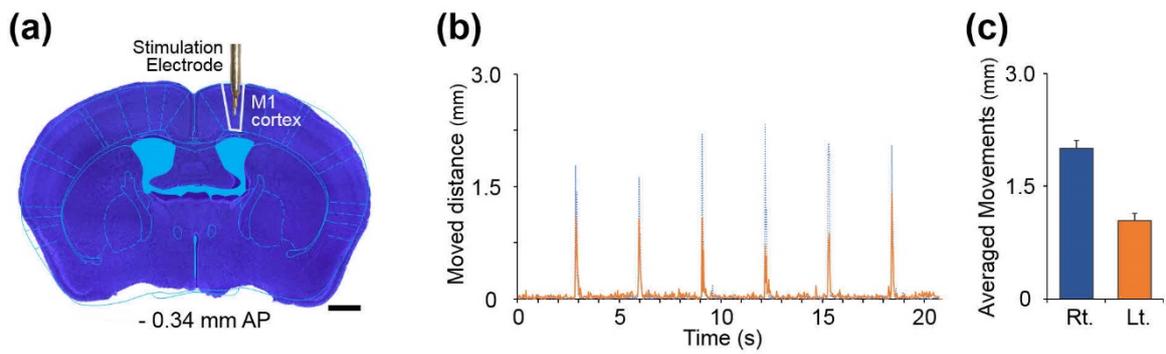
Fig. S6. (a) DAPI fluorescent image shows the localization of the stimulation electrode in brain. (Scale bar = 1 mm, AP: antero-posterior from the bregma) (b) Graph shows the distance of paw movement. [Orange solid line: left paw; Blue dotted line: right paw, same in fig. 1(e).] (c) Averaged paw movement of each paw are shown. The peak moved distances after the each stimulation are calculated during the 6 times of bending (paired t-test, p = 0.002).
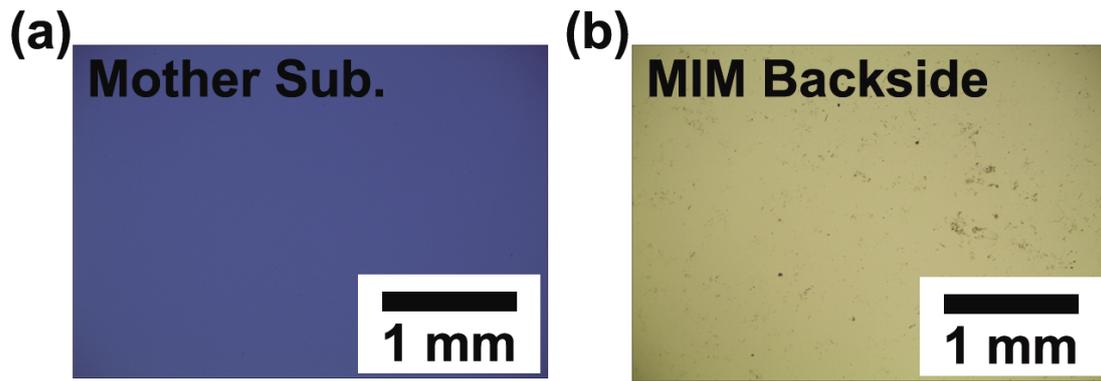
Fig. S7. Optical Microscopy (OM) images of delaminated interfaces including top surface of mother substrate (a) and backside of PIMNT MIM layer (b) after the Ni exfoliation process. The mechanical exfoliation process offered a safe and precise detachment of the piezoelectric MIM structure from the bulk silicon wafer.