Supporting Information

Airtight-Cavity-Structural Triboelectric Nanogenerator-based Insole for High Performance Biomechanical Energy Harvesting

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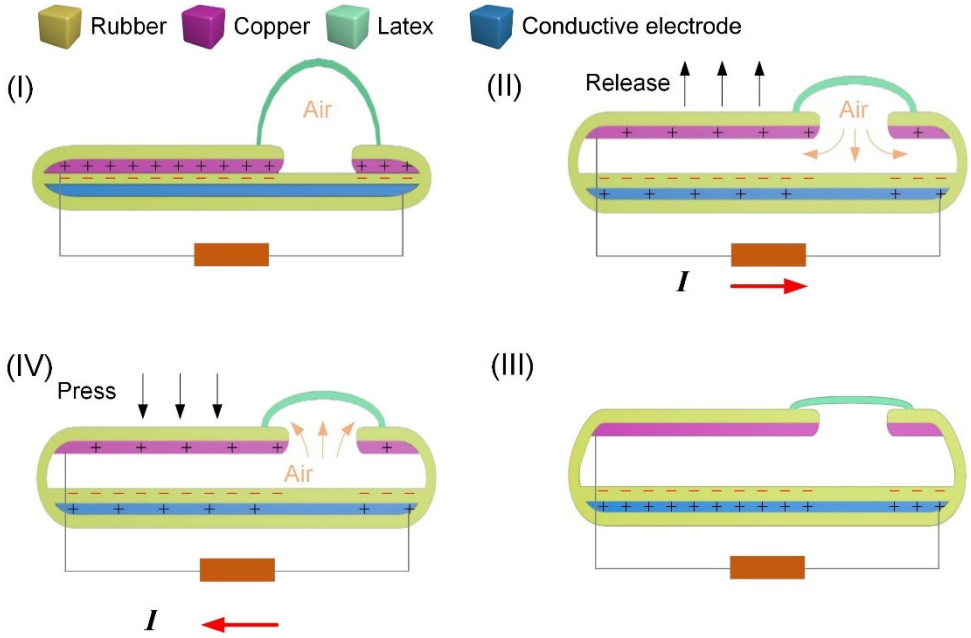

Fig. S1. Schematic diagram showing the working principles of the EHI. Schematic of the electricity-generation process in a full cycle based on the coupling effect between contact electrification and electrostatic induction.

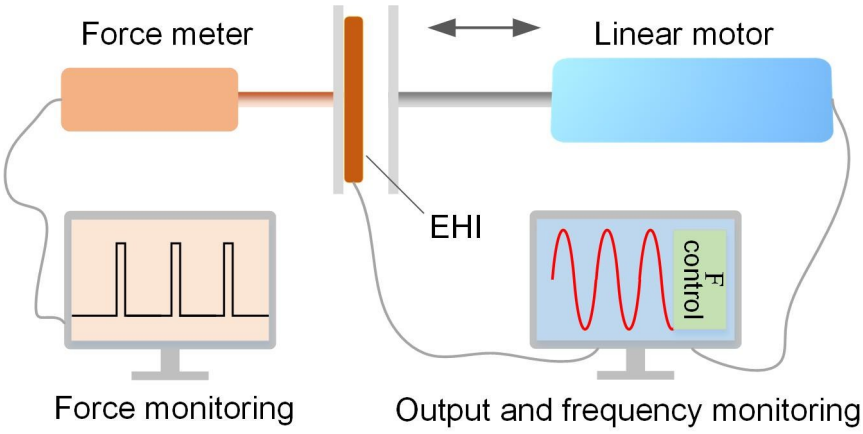

Fig. S2. Schematic illustration of the experimental test system.

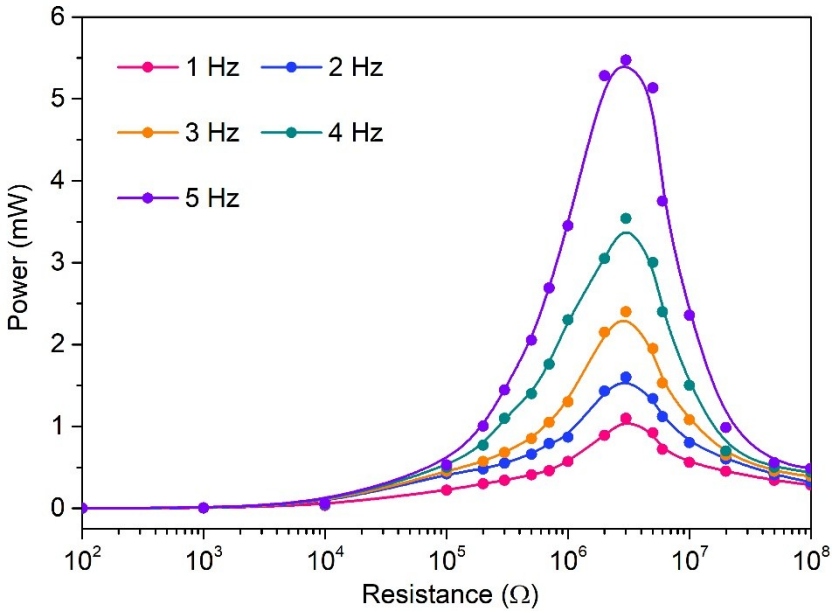

Fig. S3. The optimum output powers of the EHI under different working frequencies (1-5 Hz).

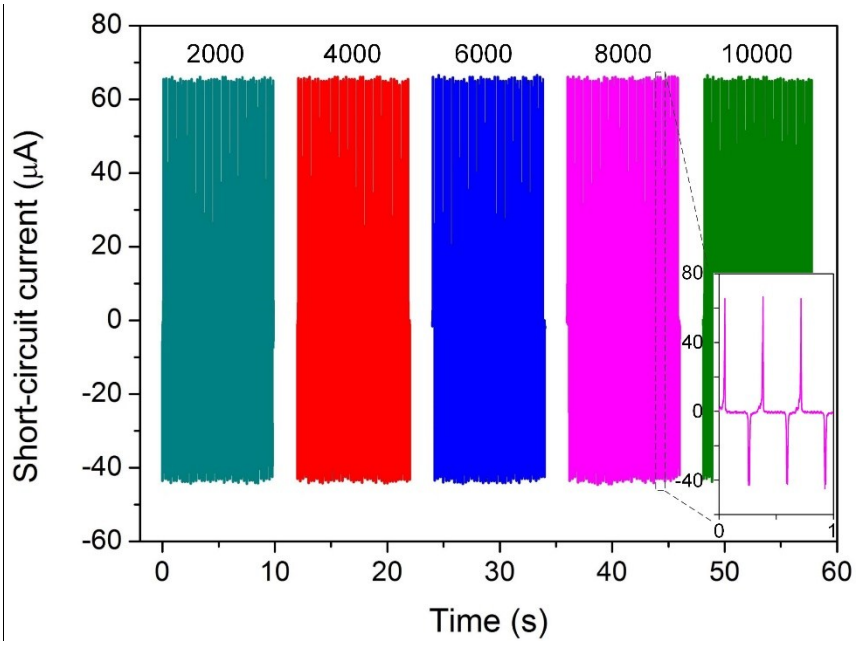

Fig. S4. Durability and stability test of the EHI for short-circuit current around 10000 cycles.

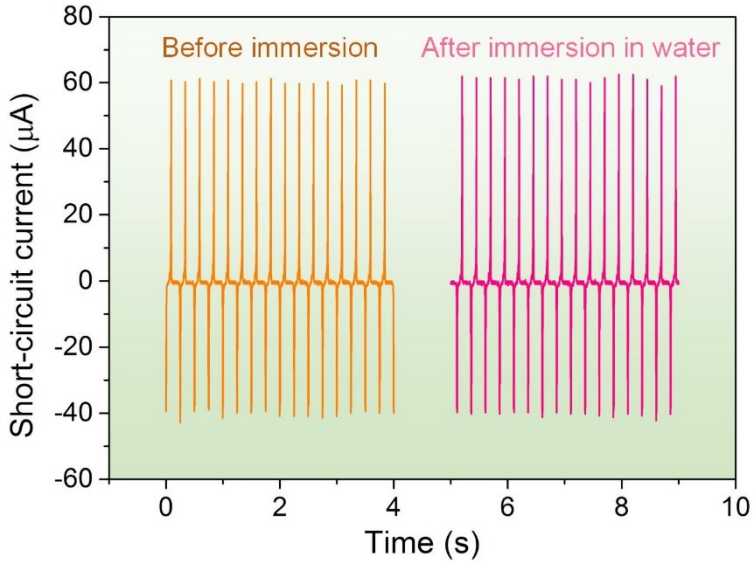

Fig. S5. Output short-circuit current of the EHI before immersion and after immersion in water.

Note 1.

The contact-mode TENG for our proposed design can be categorized as conductor-to-dielectric type, the model built for the conductor-to-dielectric category is shown in Fig. S6. In this mode, the separation distance between the two triboelectric charged layers is defined as x. σ is the static charges with equal density of the inner surface of the two triboelectric layers due to contact electrification. And the amount of transferred charges between the two electrodes is defined as Q, then the V–Q–x relationship for the sliding mode TENGs by neglecting the edge effect can be expressed as [42]:

$$V = -\frac{Q}{S\varepsilon_0}(d_0 + x(t)) + \frac{\sigma x(t)}{\varepsilon_0} \tag{1}$$

where d_0 is the effective dielectric thickness, and ε_0 is the dielectric constant of a vacuum. S is area size of the triboelectric layer. It can be found that the output voltage will increase with the elevation of separation distance x.

Thus, according to the Equations (1), the output voltage of TENG is affect by the separation distance x, which is determined by the air volume, that is, the output performance of TENG is affected by air volume in the cavity.

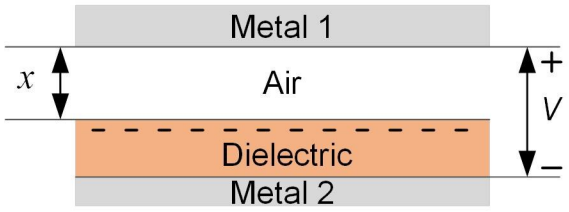

Fig. S6. Theoretical model of conductor-to-dielectric mode.

Video S1: Demonstration of the EHI harvesting biomechanical energy to drive 375 LEDs.

Video S2: Demonstration of the LED warning signs on a vest, i.e., 'CAUTION', and 'PASS'.

Video S3: Demonstration of charging a 960 uF commercial capacitor during walking.