Supporting Information

A paper triboelectric nanogenerator for self-powered electronic systems

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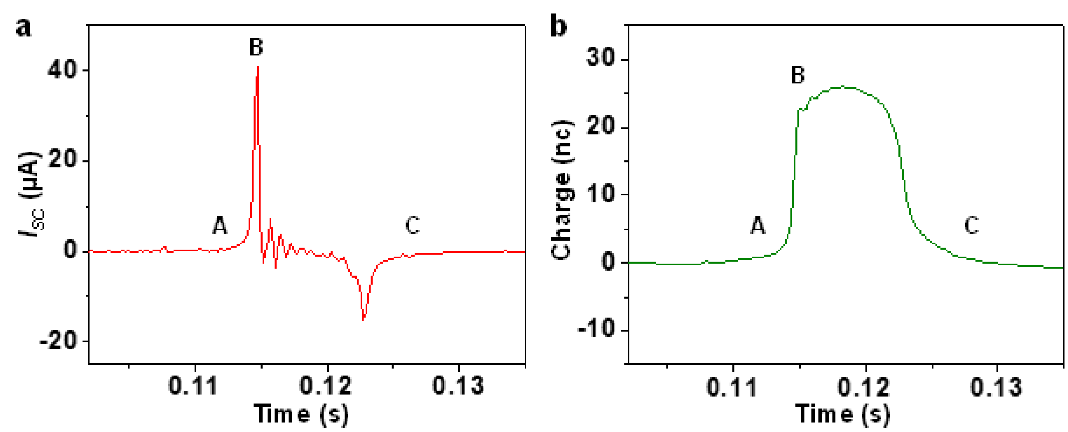

Fig. S1 (a) Output current produced from one friction cycle of the P-TENG. (b) The corresponding induced charge calculated by the integral area of the *I-t* curve in (a).

Fig. S1a exhibits the output current signal of a full contact-separation cycle. The point A, B, and C in Fig. S1a correspond to initially contact, fully contact, and fully separation state of the paper and PTFE thin film. The number of induced charge was calculated by the integral area of the *I-t* curve in Fig. S1a through the following equation:[1]

$$q = \int_{a}^{b} I \mathrm{d}t$$

where q is the induced charge, t is the time, I is the output current, and [a, b] is the time interval. and. As shown in Fig. S1b, from point A to B, the charge increased from 0 to 26 nC when the paper fully contacting with the PTFE thin film. From point B to C, the charge almost decreased to zero, which is consistent with the separating process. The charge increasing and decreasing process correspond to the positive and negative output current produced in a contact-separation cycle, respectively. These results further evidenced the working mechanism of the P-TENG (shown in Fig. 2).

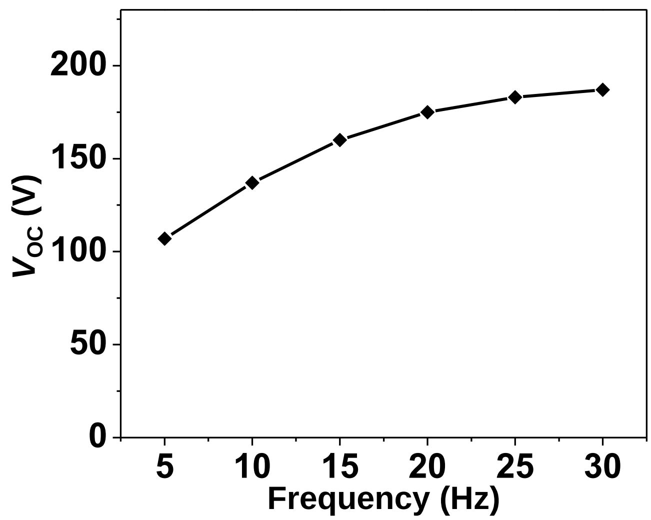

Fig. S2 The peak V_{OC} of the P-TENG under oscillation frequencies from 5 to 30 Hz.

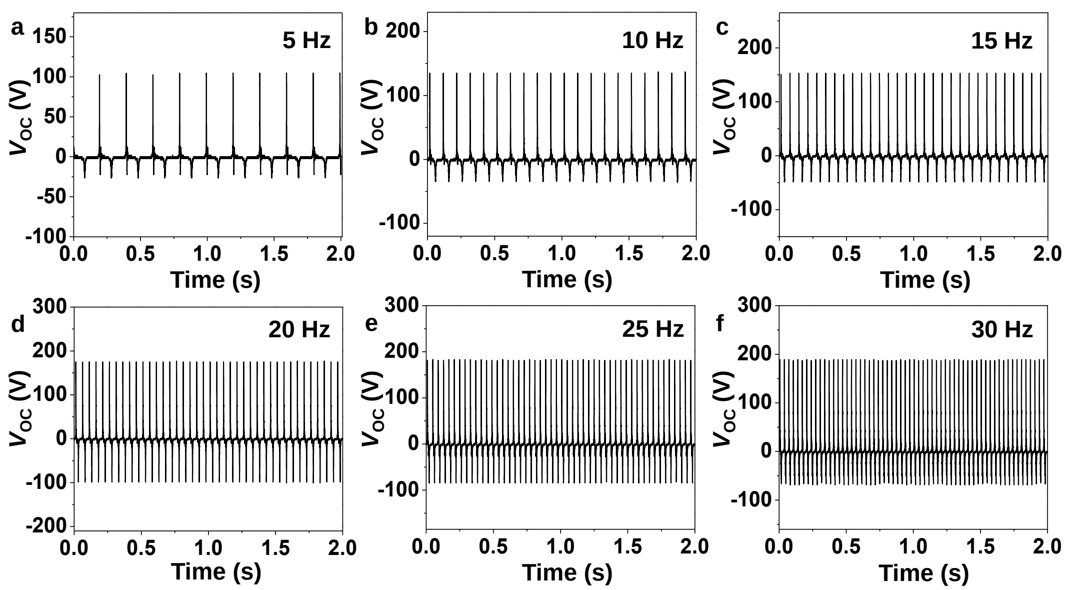

Fig. S3 Output voltage signals of the P-TENG to a range of varying oscillation frequencies.

The peak V_{OC} of the P-TENG were measured within a frequency range from 5 to 30 Hz as shown in Fig. S2 and S3. It was found that the peak V_{OC} increased from 107 to 187 V as the oscillation frequency increased from 5 to 30 Hz. The increasing of the electric output can be attributed to the raised contact-separation rate would induce more triboelectric charges within the same time frame.[2]

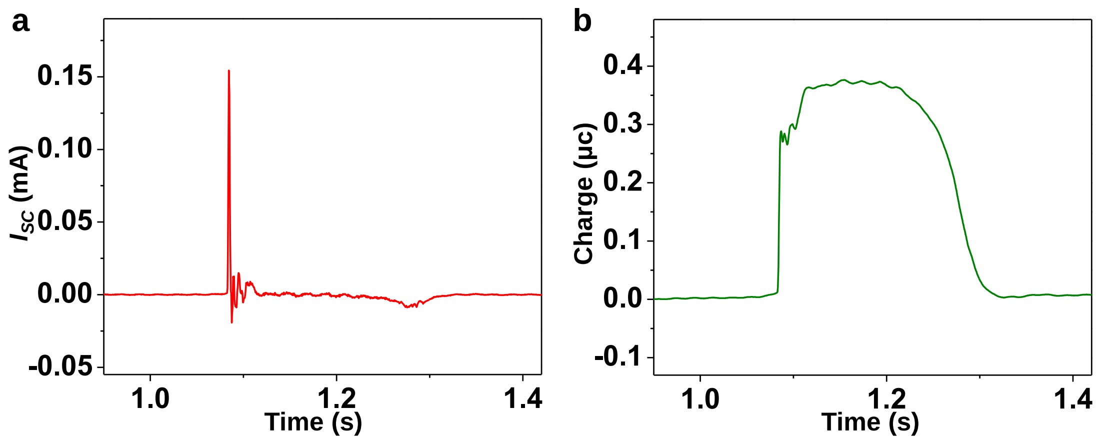

Fig. S4 (a) One cycle output current of a P-TENG within the book. (b) The corresponding output charge calculated from the integral area of the *I*-*t* curve in (a).

Fig. S4a shows one cycle output current generated from a P-TENG within the book when operated by turning the book page. As shown in Fig. S4b, the corresponding output charge of the P-TENG was calculated by the integral area of the *I*-*t* curve in Fig. S4a. When operated by the action of turning the book page, the P-TENG could generate 0.38 μC output charge.

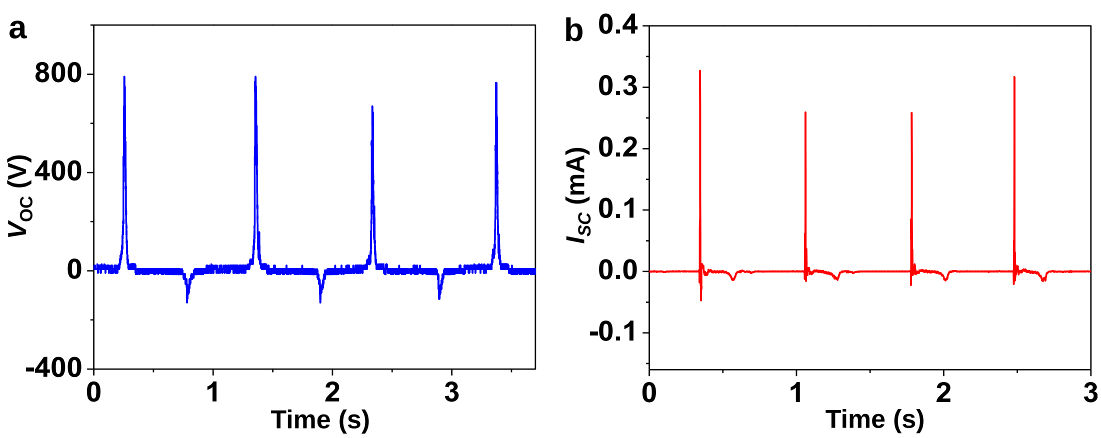

Fig. S5 (a) Output voltage measured from two P-TENGs (10 cm × 15 cm each) when they were connected in series. (b) Output current of these two P-TENGs when they were connected in parallel.

Two P-TENGs were fabricated and integrated onto adjacent pages in a book. These two P-TENGs can be simultaneously operated by one action of page turning. As shown in Fig. S5a, by connecting these two P-TENGs in serial, the peak V_{OC} reached 790 V. For the parallel connection, the peak I_{SC} was obtained to be 0.33 mA (Fig. S5b). The peak V_{OC} in serial connection was approximately twice the peak V_{OC} of one P-TENG. Correspondingly, the peak I_{SC} in parallel connection was approximately twice the peak I_{SC} of one P-TENG. This result revealed that the P-TENG connection followed the general rules of battery connection.

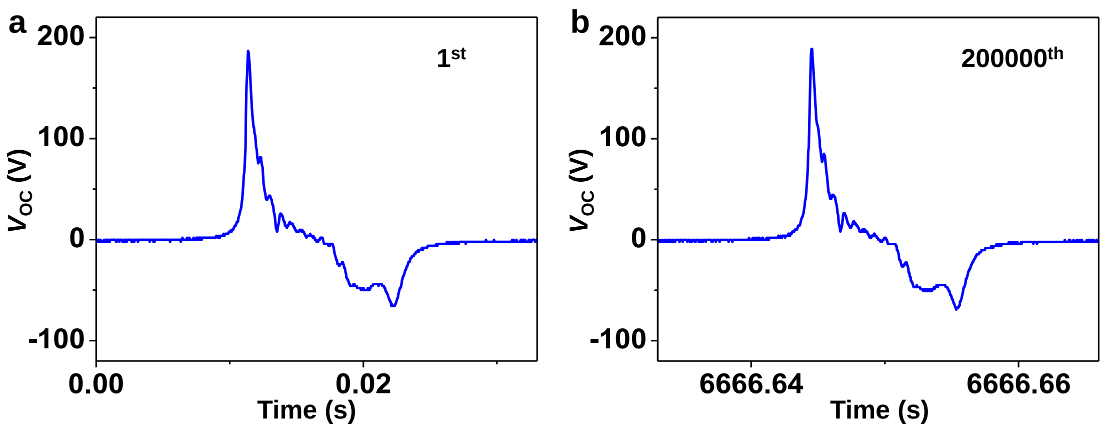

Fig. S6 The enlarged voltage output patterns of the 1st and 200000th cycle in Fig. 4a.

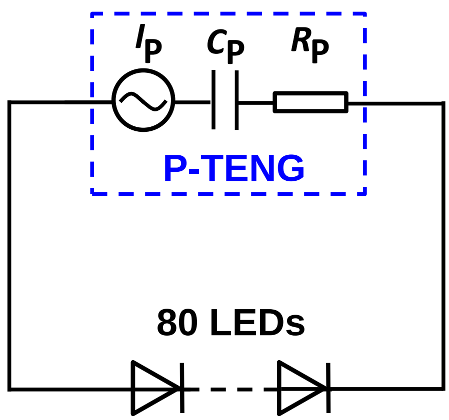

Fig. S7 The equivalent circuit for powering 80 LEDs connected in series by the P-TENG.

Video S1 80 commercial white LEDs were directly powered up when the P-TENG was operated by the action of turning book pages.

Video S2 White LEDs powered by the P-TENG can provide sufficient illumination for reading printed text in darkness.

References

1. Z. H. Lin, G. Cheng, L. Lin, S. Lee and Z. L. Wang, *Angew. Chem., Int. Ed.*, 2013, **52**, 12545-12549.
2. Y. Mao, D. Geng, E. Liang and X. Wang, *Nano Energy*, 2015, **15**, 227-234.