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Harvesting heat energy from ambient available wastewater by using pyroelectric generator for driving electronic devices

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Supporting information

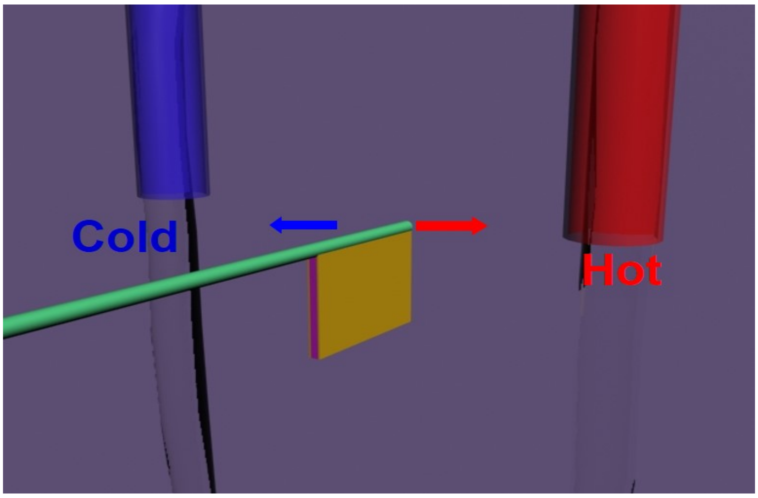

Figure S1 Schematic diagram of the structure and working procedure of the PVDF film. The pyroelectric generator moves to the left and right under an electric oscillator to contact with the hot and cold flows. Once the pyroelectric generator contacts with the flow (hot or cold), there is a current output. As the PEG moves continuously, there is a sustainable output which can be detected and collected.

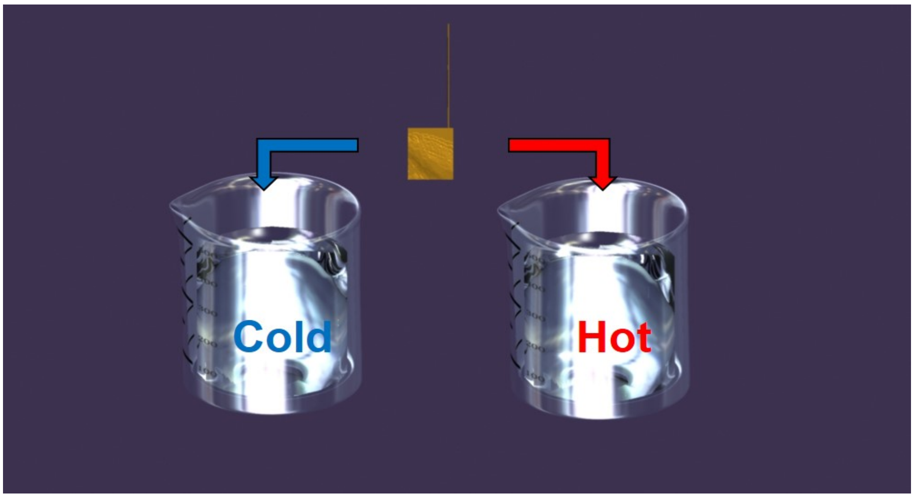

Figure S2. Schematic diagram of the working procedure of the device conducted manually.

Since the diameter of the water pipe is smaller than the size of the PVDF film, the water flow cannot soak the whole surface of the film which makes it difficult to simulate the situation. In order to get rid of vibration influence on the output current, we manually control the device to contact with the hot water and the cold water alternatively in two beakers.

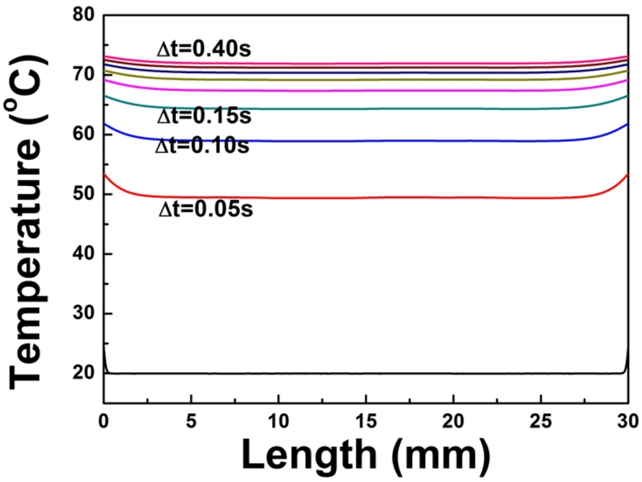

Figure S3. The different temperature distribution at different time when putting the device in the hot water at 80°C.

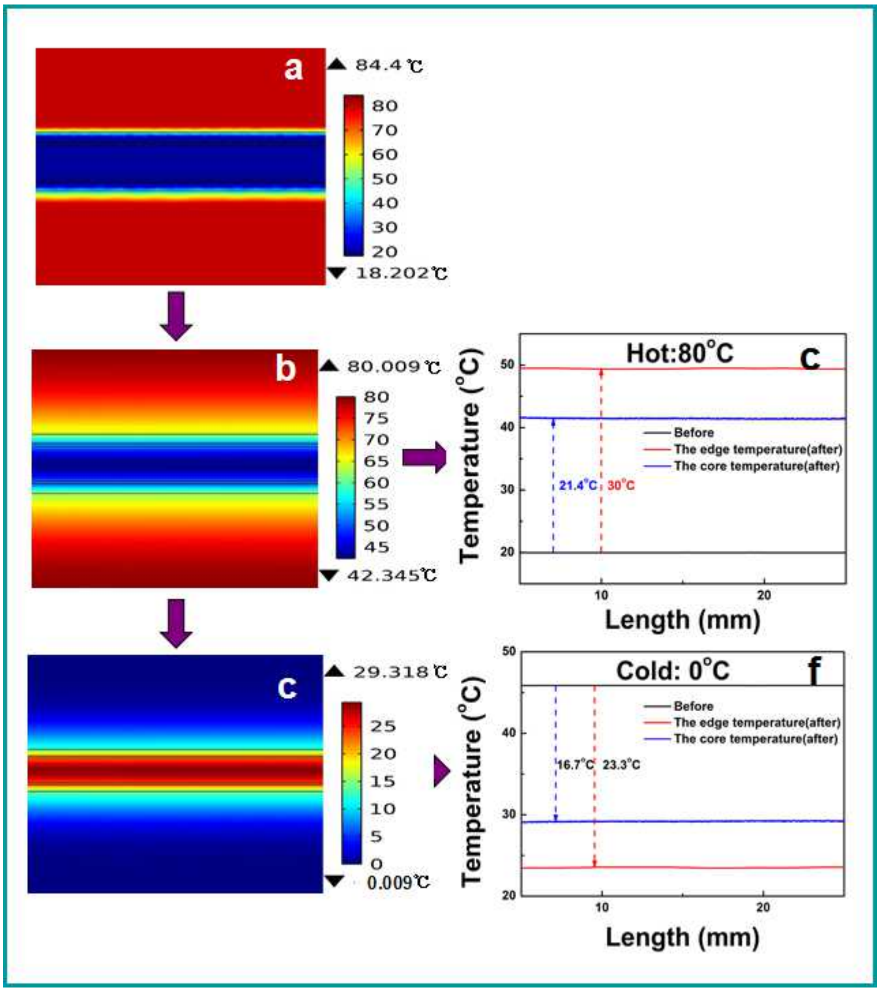

Figure S4. Simulation of the temperature distribution and difference across the PVDF film before and after contacting the 80℃ hot water and the 0℃ cold water.

(a) The temperature distribution at the moment when the film is fully immersed into the hot water at t=0 s. (b) The temperature distribution at the moment when the output current reaches the highest value at about t=0.05 s. (c) The temperature difference of the central plane and the edge surface at 0s and 0.05s in hot water. (d) The temperature distribution after the PVDF film is rapidly put into the cold water from the hot water, lasting for 0.05s. (e) The temperature difference of the central plane and the edge surface at 0s and 0.05s in cold water.

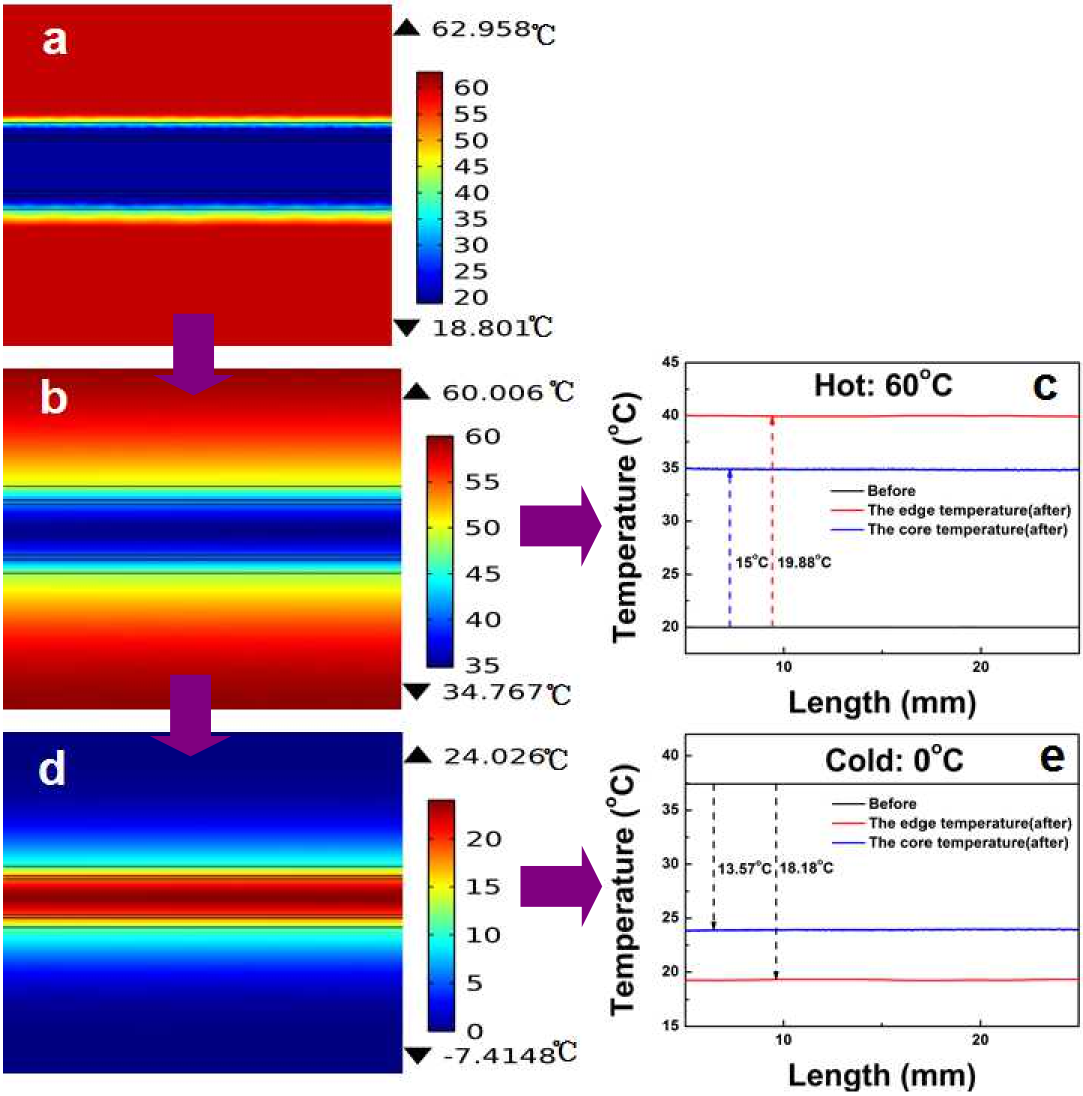

Figure S5. Simulation of the temperature distribution (left) and difference (right) on the PVDF film before and after contacting with the 60℃ hot water (a, b, c) and the 0℃ cold water (b, d, e).

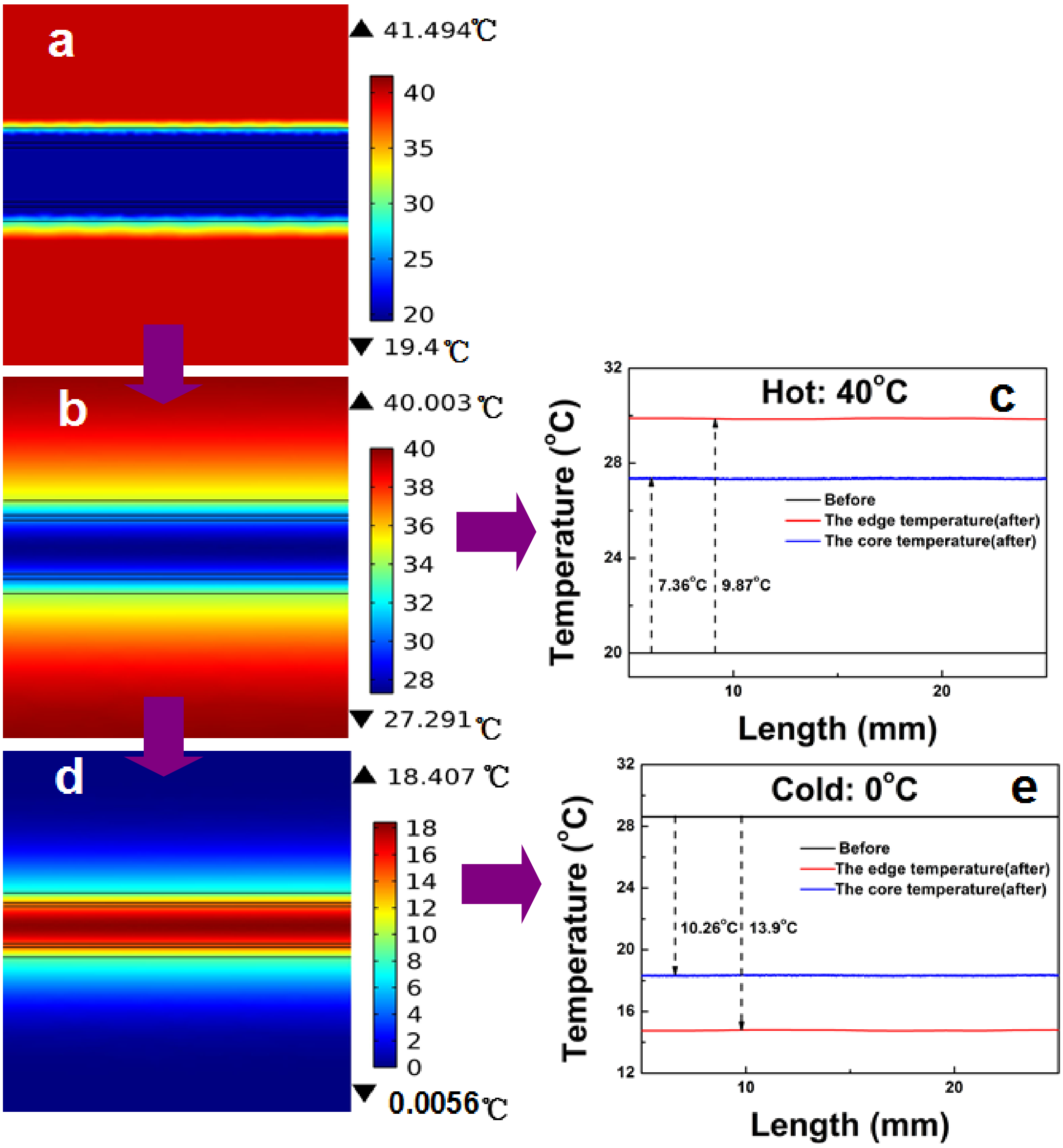

Figure S6. Simulation of the temperature distribution (left) and difference (right) on the PVDF film before and after contacting with the 40℃ hot water (a, b, c) and the 0℃ cold water (b, d, e).

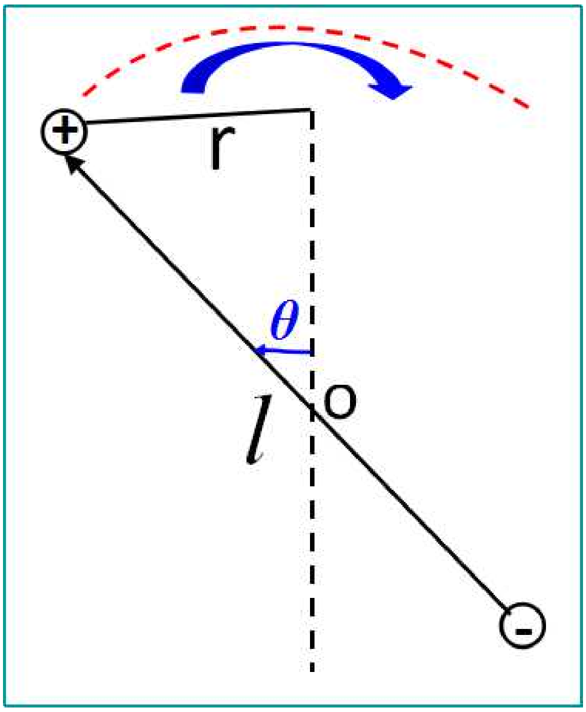

Figure S7. The relationship between the wiggling angle and the dipole moment. Set point O as the midpoint of the dipole moment. The functional relationship between the wiggling angle θ and the dipole moment l is present as follows.

$$\sin\theta = \frac{r}{l}$$

So when the dipole moment l (or the distance r) changes, the rotating angle θ also changes.

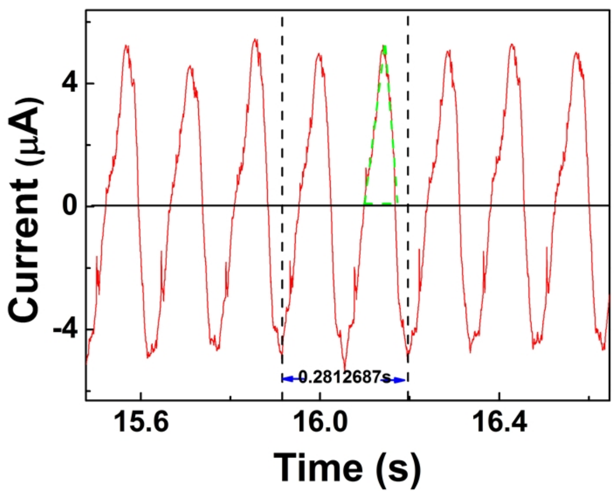

Figure S8. The detail calculation of charge transfer quantity. Take the current under 7 Hz in Figure 8c as an example. As is shown in Figure S8, the area circled with green dash line means charge transfer quantity in half cycle due to the equation *dQ=idt*. As dt =0.2812687/4 (s), i =5.6889 μA, we calculate dQ =0.2 μC. Considering per unit time, the charge transfer quantity Q^* =*dQ*/*dt* =2.844 μC/s.