Electronic Supplementary Information

Electrification based devices with encapsulated liquid for energy harvesting, multifunctional sensing, and self-powered visualized detection

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There are two possible charge distribution models for this device as listed below.

Model 1: *Water and PE surface have the same amount of charge but different sign. The total charge in the system is zero.*

Model 2: *Only PE surface has negative charge. The total charge in the system equals to the charge quantity at PE surface.*

Based on these two models, the potential of top electrode at open-circuit condition and total charge of top electrode at short-circuit condition are simulated. Distance change operation mode is used in the simulation by moving the rectangle-shaped water from the bottom to the top. The open-circuit voltage and short-circuit transferred charge is then obtained by calculating the value difference between the ending and starting states (*i.e.*, when the water is at the top and at the bottom). Output performance with different volume of water (from 10% to 90% of the total volume of the container) is simulated. Since the obtained value in Model 2 is much smaller than that of Model 1, the open-circuit voltage and short-circuit transferred charge are normalized for comparison as shown in Fig. S1. In Model 1, both the open-circuit voltage and short-circuit transferred charge decrease at larger volume of water. By contrast, in Model 2, these two values increase first and reaches maximum when the percentage of water is about 60%~70%.

From the above simulated results, we can conclude that the charge distribution will affect the simulated results. By comparing the simulated results from these two models with the experimental data in Fig. 3a, Model 1 shows good consistency while Model 2 gives an opposite tendency. Therefore, Model 1 is utilized in the FEM simulation to further investigate the potential and charge distribution at different states.

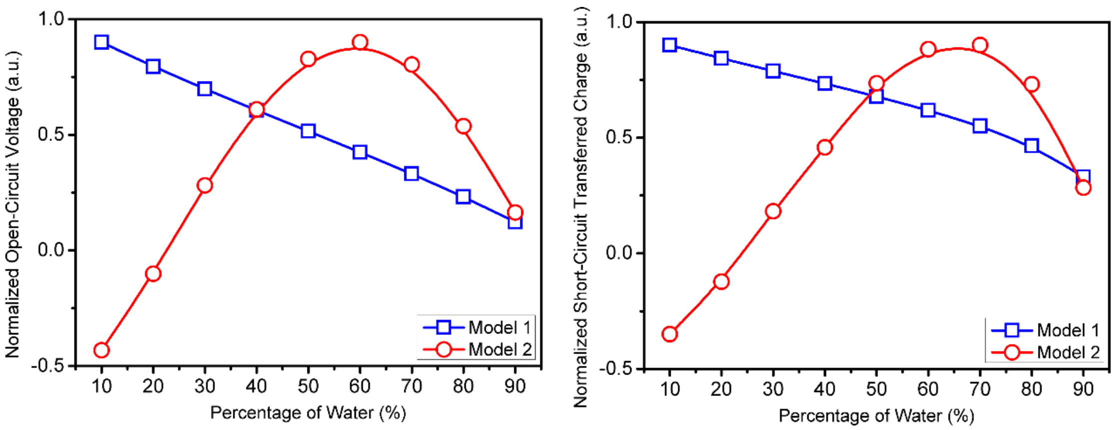

Fig. S1 Simulated results based on two different models. (a) Open-circuit voltage and (b) short-circuit transferred charge with different volume of water.

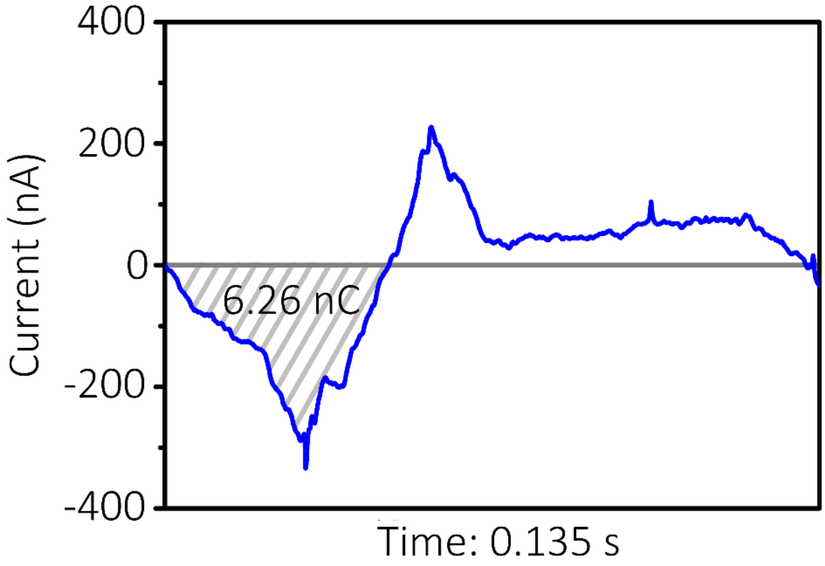

Fig. S2 Short-circuit current and the transferred charge at half cycle.

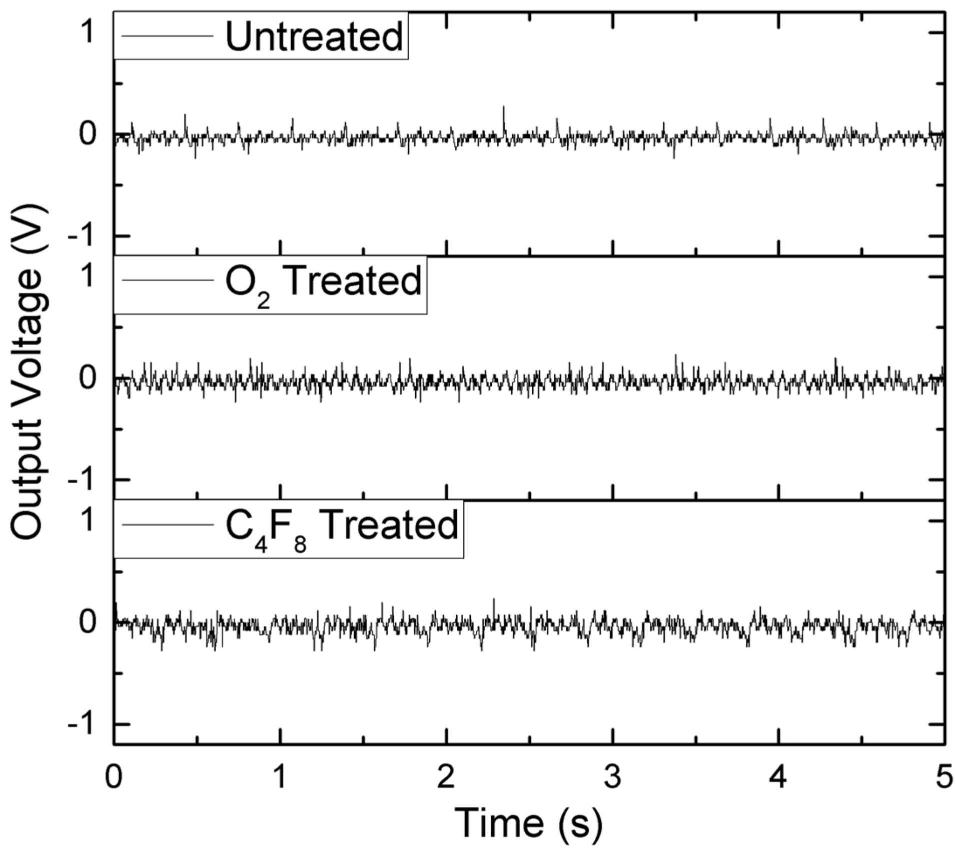

Fig. S3 Output voltage under different treatment with 4 mL encapsulated ethanol.

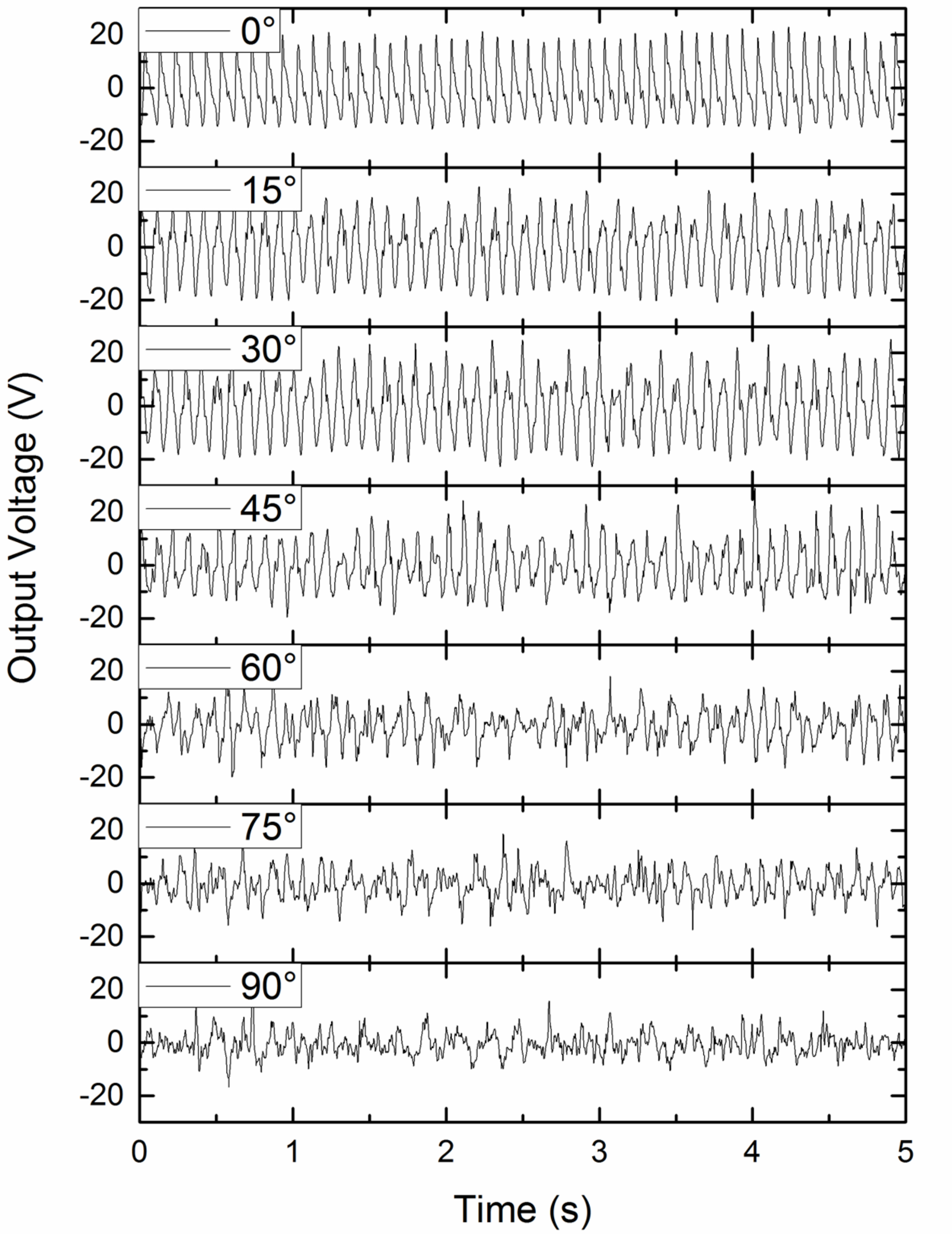

Fig. S4 Real time output voltage of the device under different rotate angles along X axis.

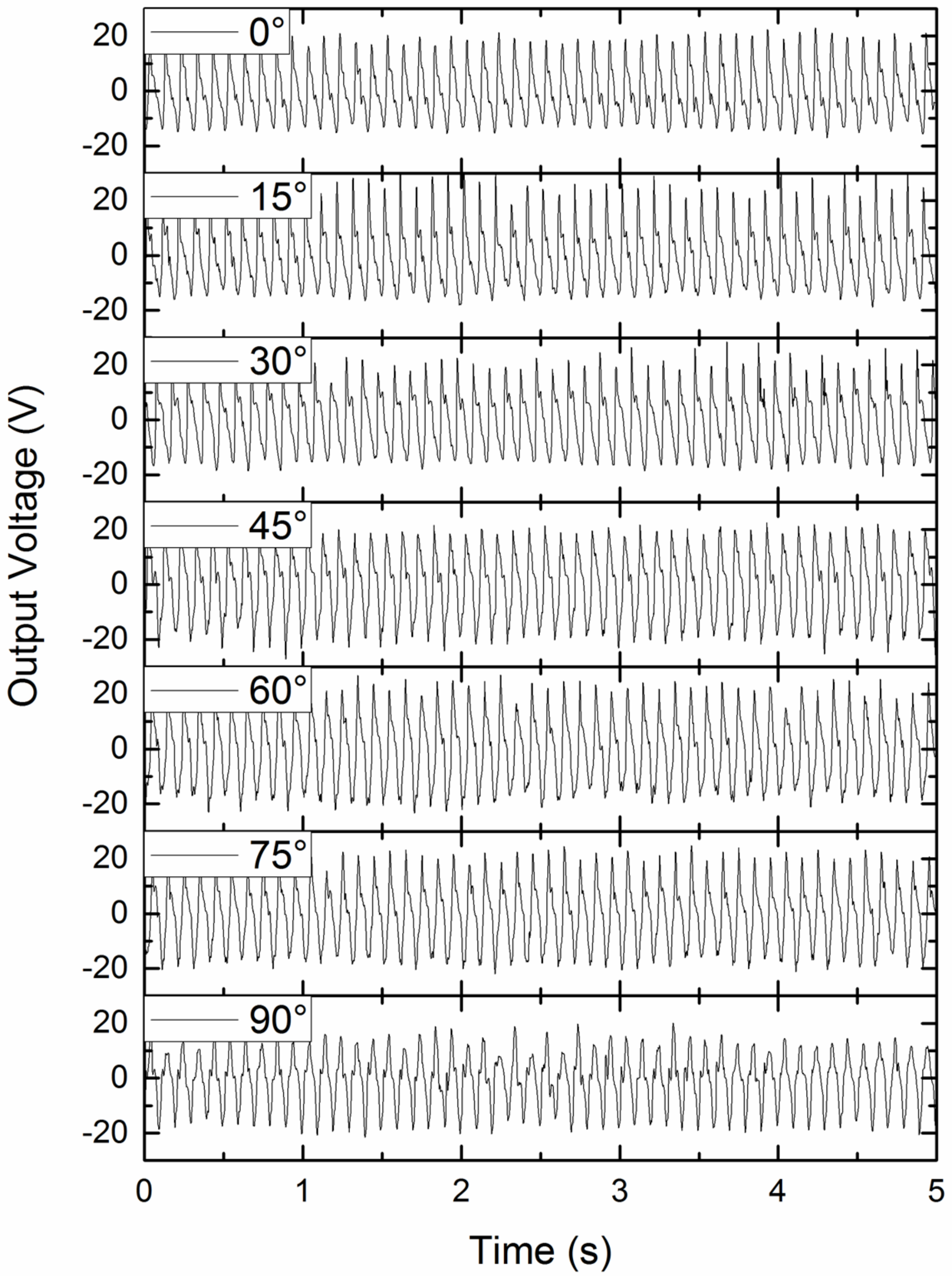

Fig. S5 Real time output voltage of the device under different rotate angles along Y axis.

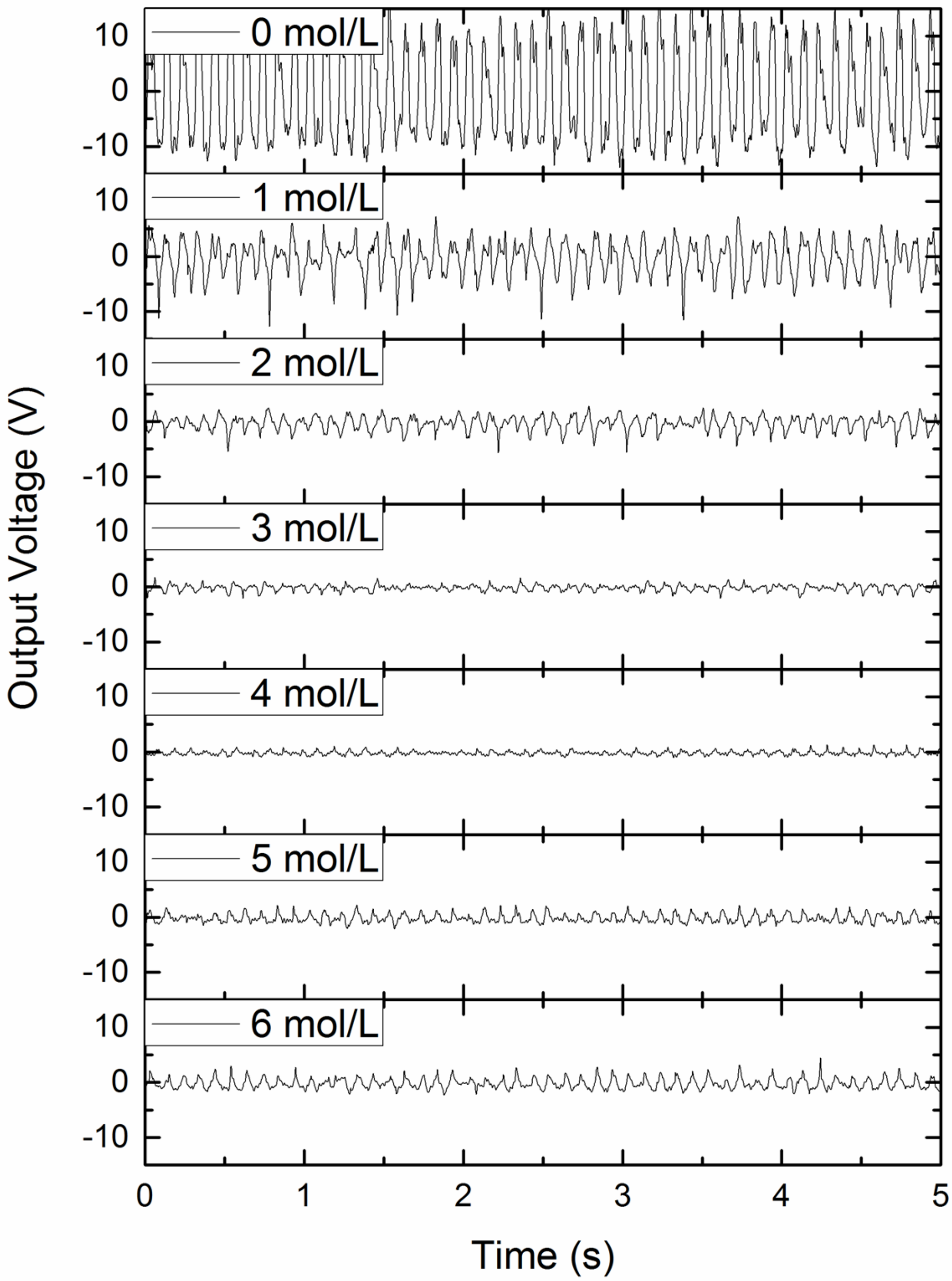

Fig. S6 Real time output voltage of the device under different concentration of NaCl solutions.

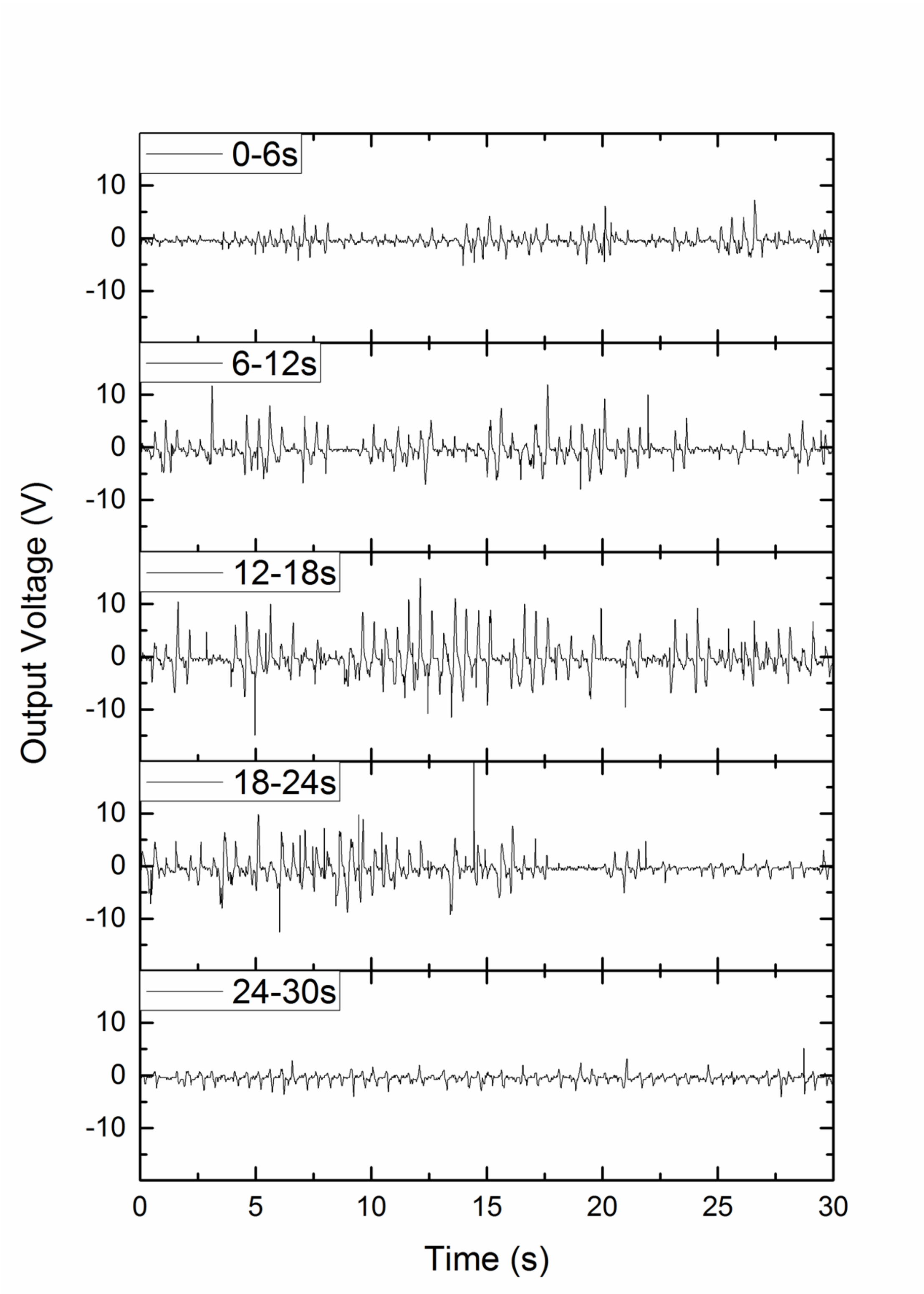

Fig. S7 Real time output voltage of the device when water begins to leak (from 0 to 30 s).

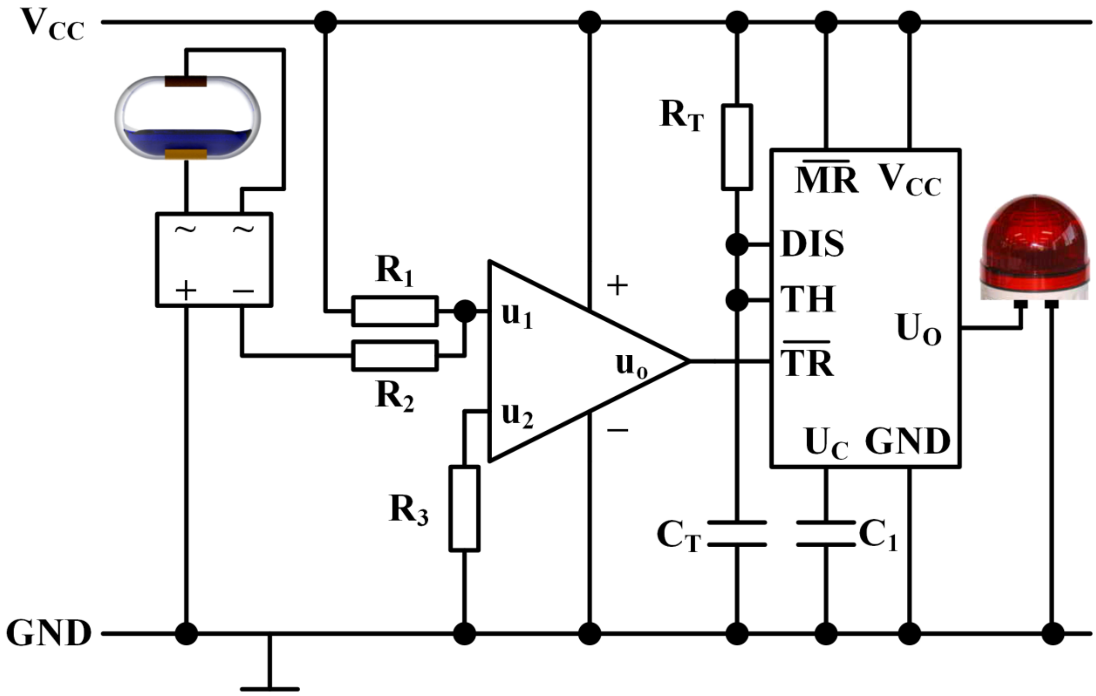

Fig. S8 Electric circuit for triggering the alarm system.