Supporting Information

High performance flexible and integratable MEG device from sulfonated carbonsolid acids containing strong Brønsted acid sites

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1. Preparation of SAC.

Mix 5g activated carbon with 30mL H_2SO_4 (98wt%) and heat to 180°C for 24h.After cooling to room temperature, the solution was filtered, and the solid was washed with deionized water until the filtrate was detected without sulfate by $BaCl_2$.The obtained SAC was dried at 70°C.

2. Preparation of CSC.

20 g of cellulose powder is slowly added to 60 mL of concentrated H_2SO_4 (98 wt%). The mixture was stirred vigorously and heated to 250°C for 2h. After cooling to room temperature, the solution was filtered, and the solid was washed with deionized water until the filtrate was detected without sulfate by $BaCl_2$.The obtained CSC was dried at 70°C.

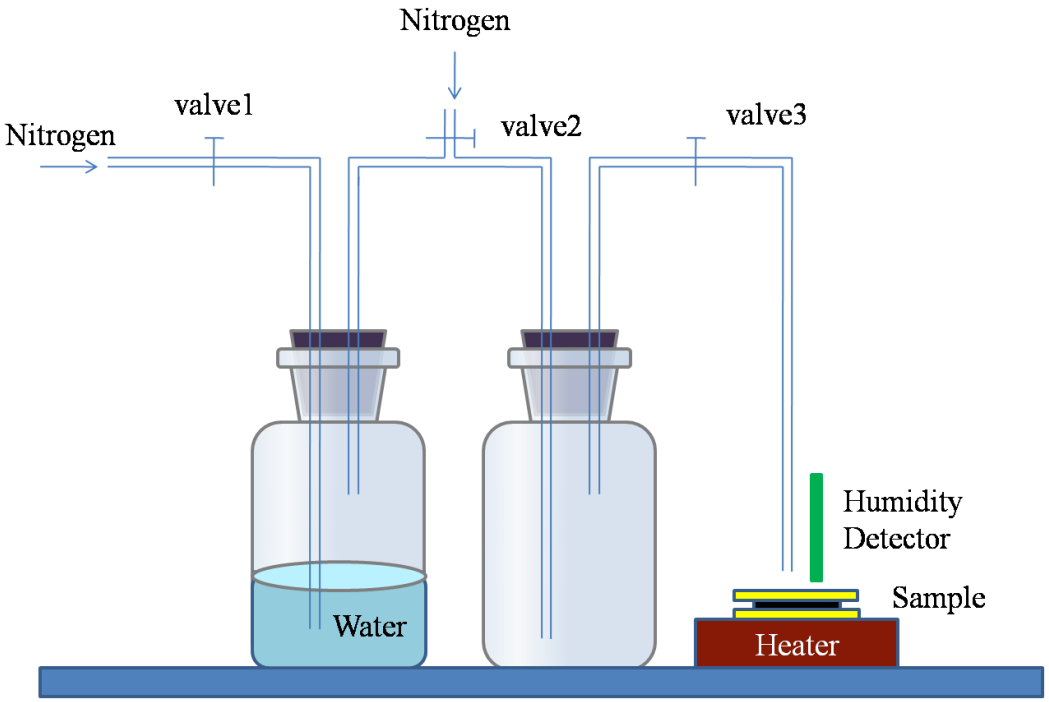

Fig. S1. The schematic diagram of moisture circulating system.

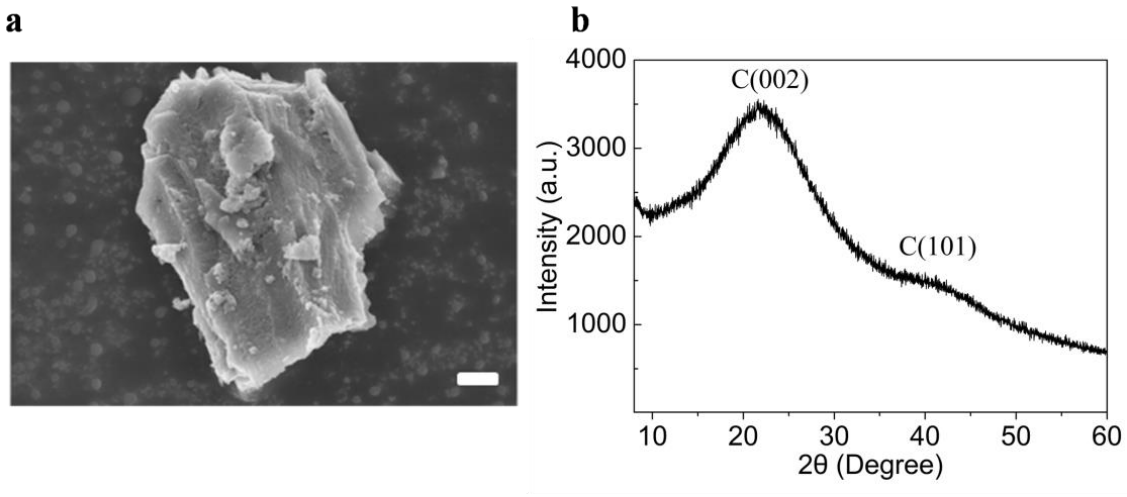

Fig. S2. (a) SEM images of SC; (b) XRD pattern of SC. Scale bars: (a) 2μm.

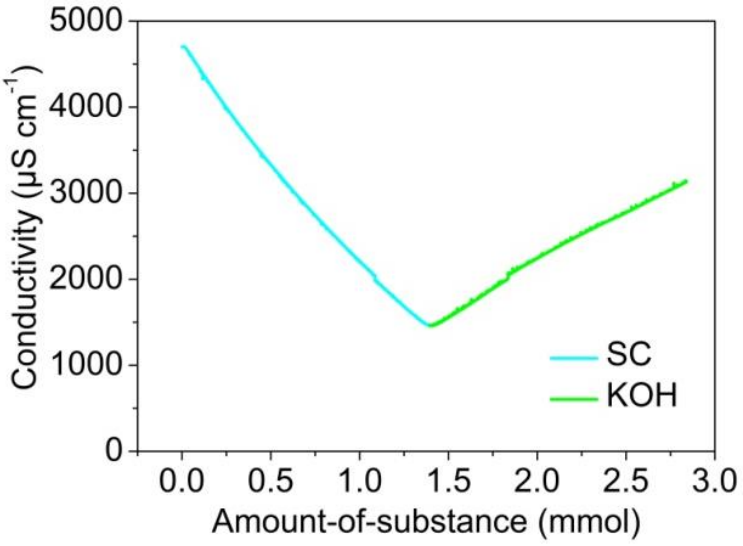

Fig. S3. Conductivity titration of SC.

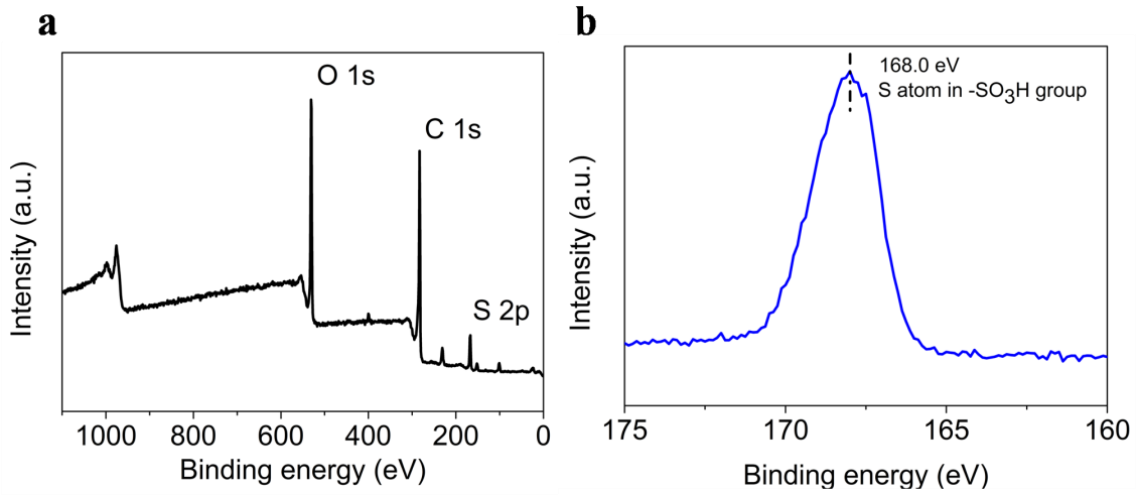

Fig. S4. (a) XPS survey spectrum of the SC; (b) High-resolution S 2p spectra of SC.

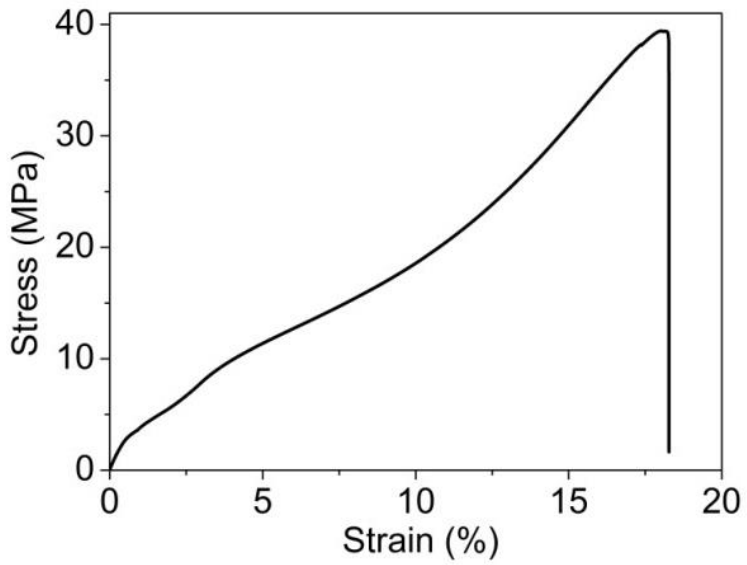

Fig. S5. Stress-strain curves of the PSM.

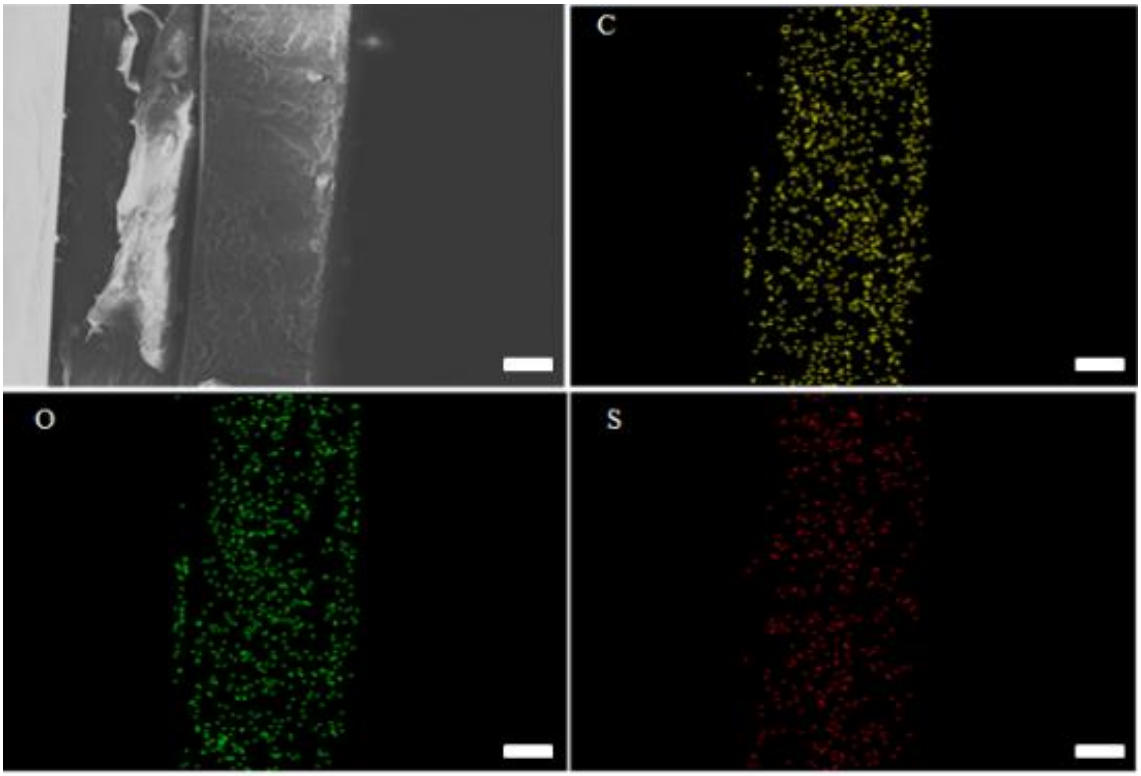

Fig. S6. Side Surface SEM images of PSM and element distribution of C, O, and S in PSM. Scale bars: (a) 50μm; (b) 50μm; (c) 50μm; (d) 50μm.

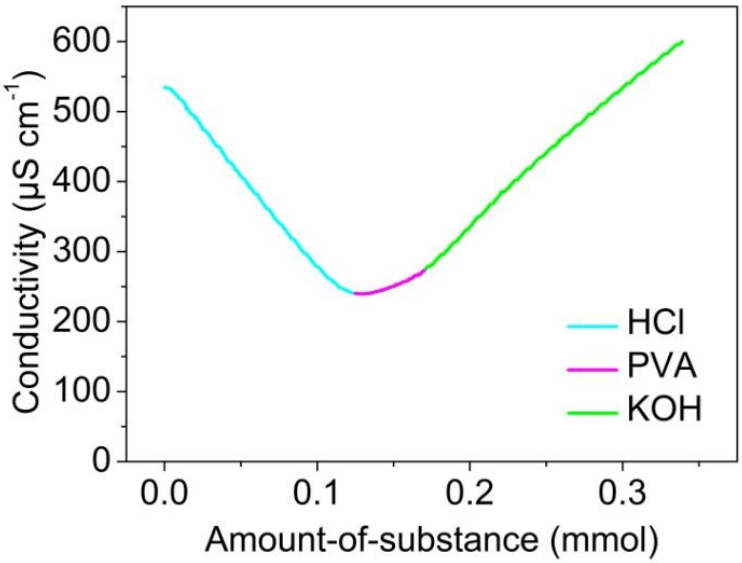

Fig. S7. Conductivity titration curve of PVA acidified with HCl.

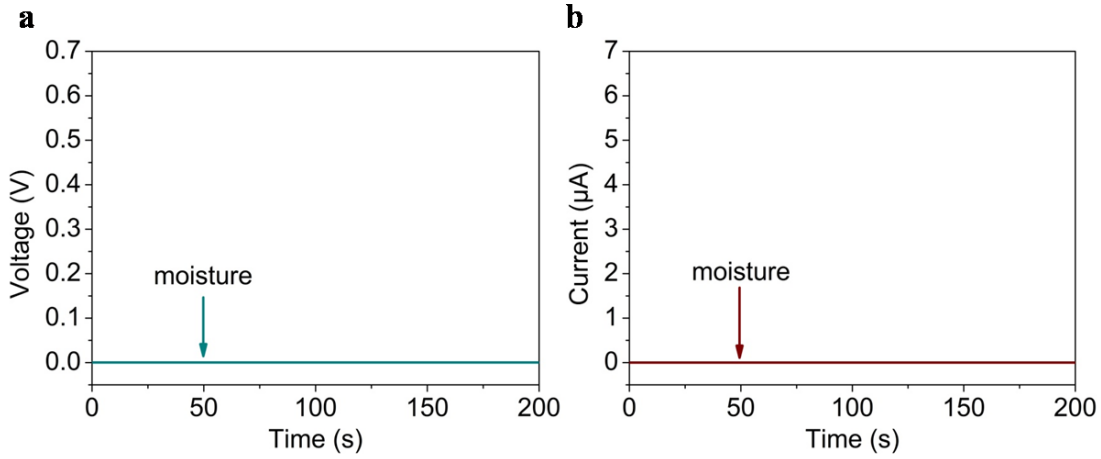

Fig. S8. (a) Voltage and (b) current output of MEG using Au@quartz when PSM is removed (electrode-air-electrode). Sample area: 1.2 cm^2, at 25 °C with 70% ΔRH.

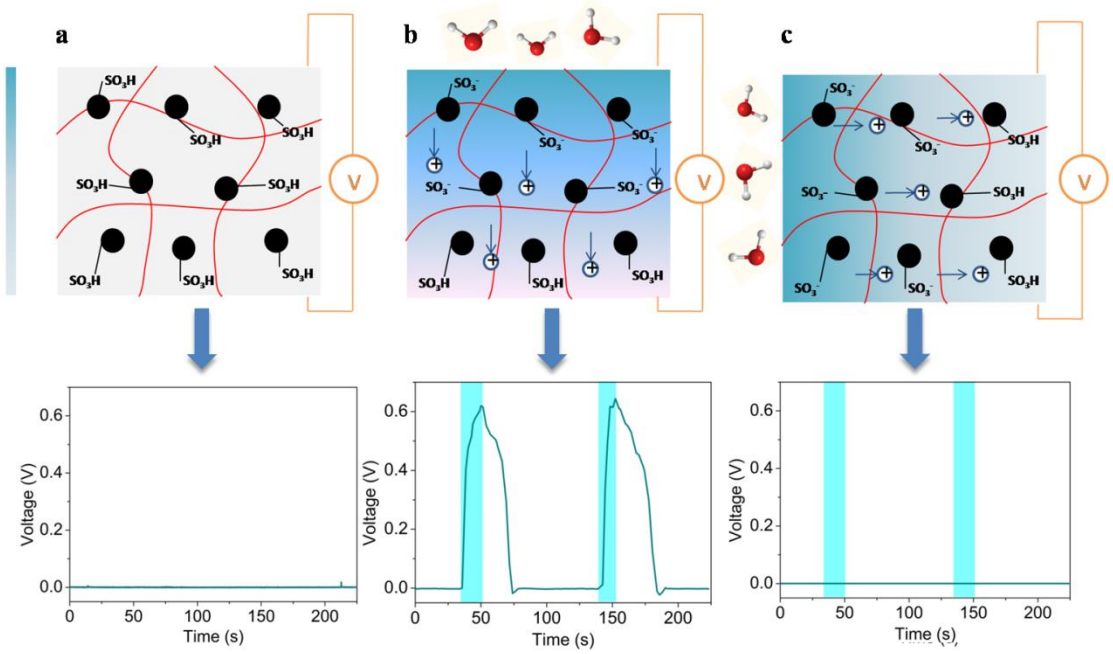

Fig. S9. The induced voltage of rSC-MEG under different humidity conditions ((a) no humidity; (b) positive humidity; (c) lateral humidity) the induced voltage of rSC-MEG.

Under different wetting conditions, ion movement and voltage output in PSM-1. Blue corresponds to wetting; white corresponds to dry and the degree of wetting increases as the blue becomes darker. (a)When the PSM-1 is dry, the H^+ in the PSM-1 do not move, and the SC-MEG has no voltage output. (b) Moisture is blown from the top electrode to the bottom electrode, and H^+ migrate to the bottom electrode. A difference in ion concentration is formed between the two electrodes of SC-MEG, and there is a voltage output. (c) Moisture is blown toward the SC-MEG from the side, and H^+ migrate along the wetting direction of the PSM-1. There is no ion concentration difference between the two electrodes of the SC-MEG, and there is no voltage output. Sample area: 1.2 cm^2, at 25 °C with 70% ΔRH.

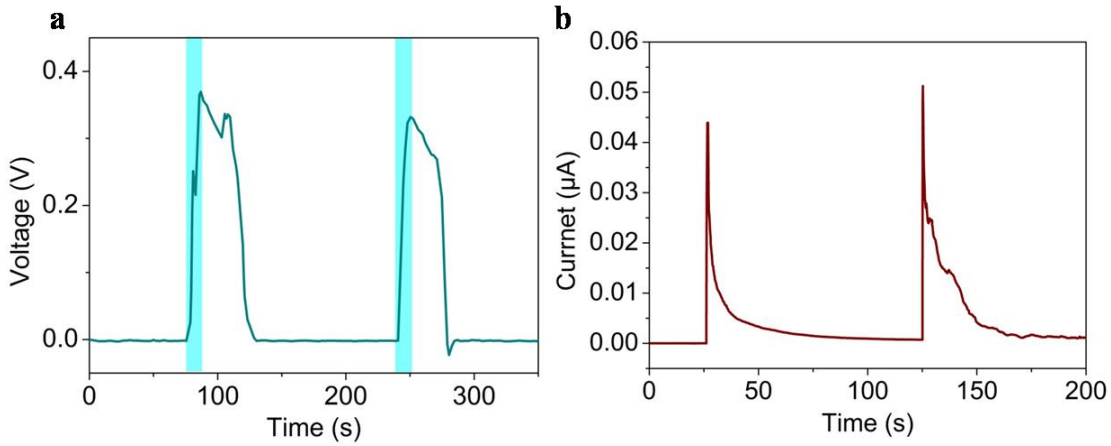

Fig. S10. (a) Voltage and (b) current output of SAC-MEG. Sample area: 1.2 cm^2, at 25 °C with 70% ΔRH.

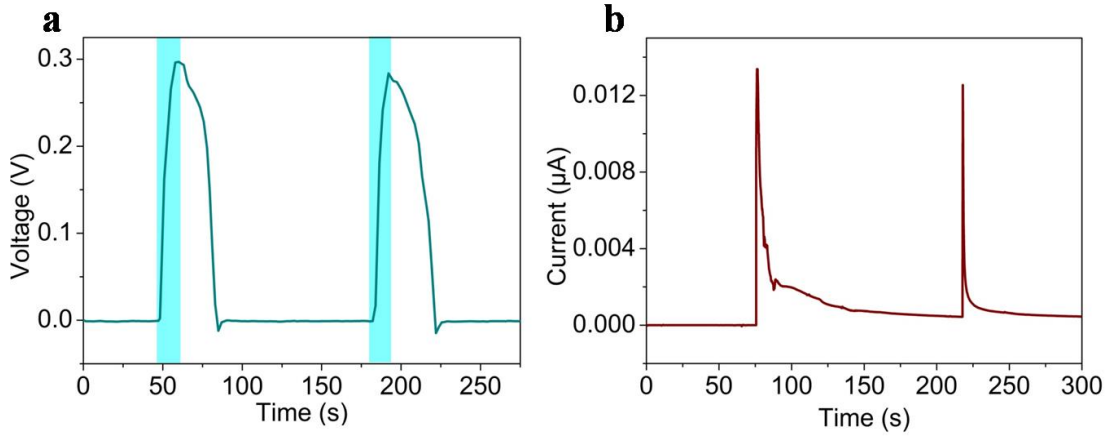

Fig. S11. (a) Voltage and (b) current of MEG using PVA.

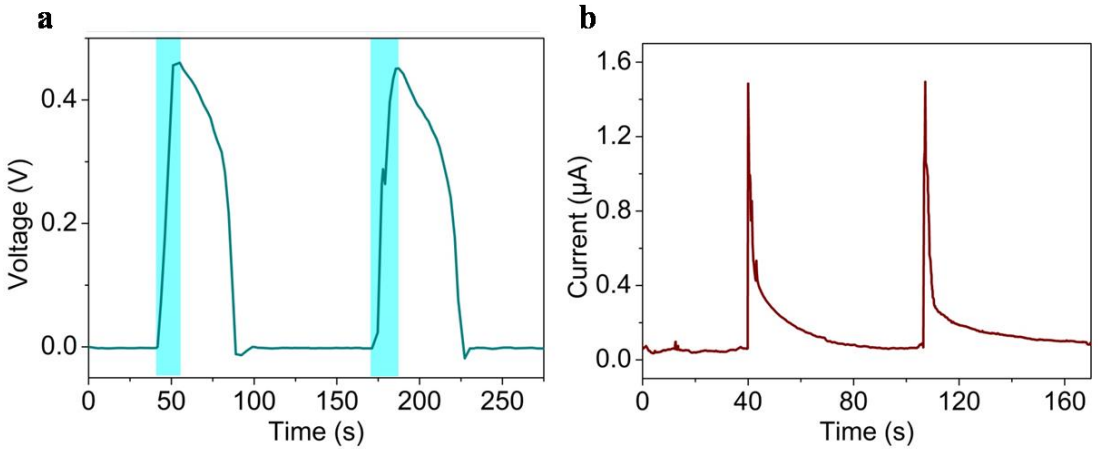

Fig. S12. (a) Voltage and (b) current output of CSC-MEG. Sample area: 1.2 cm^2, at 25 °C with 70% ΔRH.

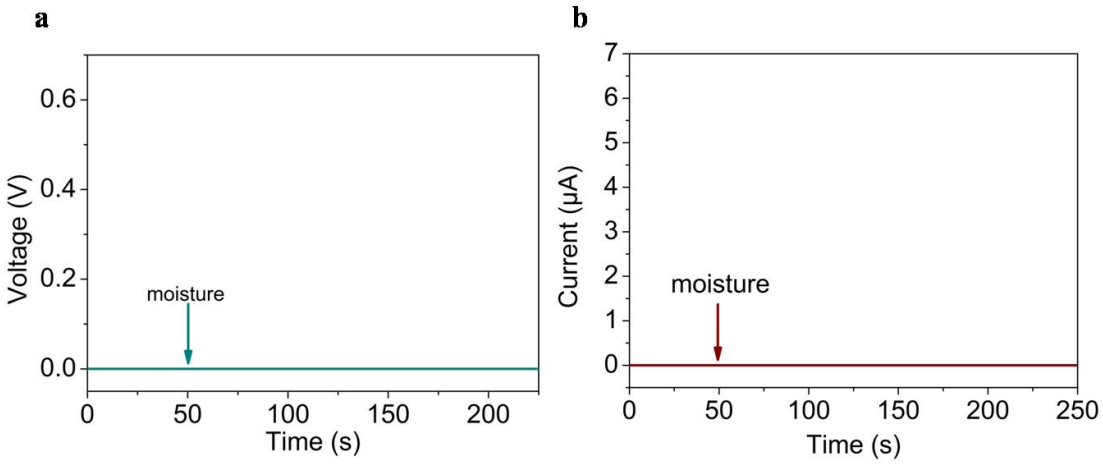

Fig. S13. (a) Voltage and (b) current output of MEG using Ag@PET when PSM is removed (electrode-air-electrode). Sample area: 1.2 cm^2, at 25 °C with 70% ΔRH.

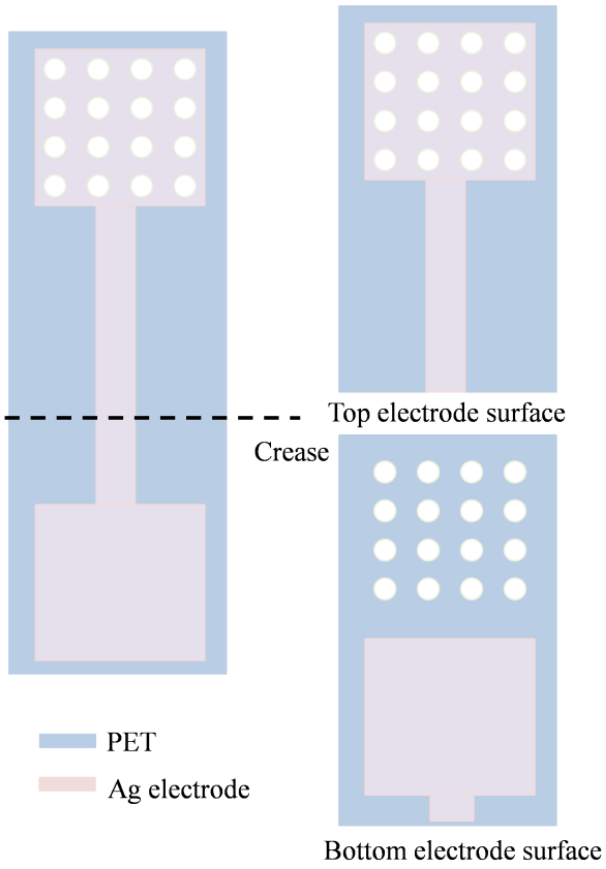

Fig. S14. Schematic diagram of CIPS electrodes.

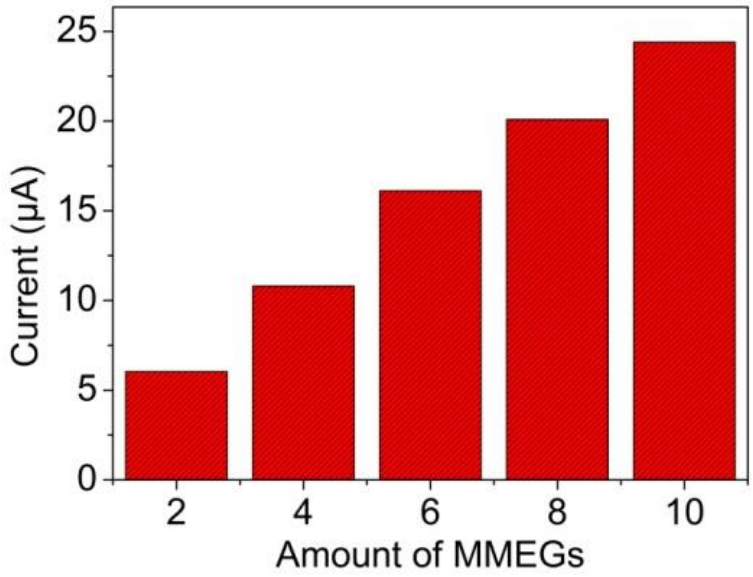

Fig. S15. Parallel current curve of the SC-MEGs. Sample area: 1.2 cm^2, at 25 °C with 70% ΔRH.