Supporting Information

Flexible supercapacitors with high capacitance retention at temperatures from -20 to 100 °C based on DMSO-doping polymer hydrogel electrolytes

Yanan Liu,[a] Huili Li,[a] Xue Wang,[a] Tian Lv,[a] Keyi Dong,[a] Zilin Chen,[a] Yunlong Yang,[a] Shaokui Cao,[b] Tao Chen*[a]

[a]*Shanghai Key Lab of Chemical Assessment and Sustainability, School of Chemical Science and Engineering, Tongji University, Shanghai 200092, P. R. China. E-mail: tchen@tongji.edu.cn*

[b]*School of Materials Science and Engineering, Zhengzhou University, Zhengzhou, 450001, China.*

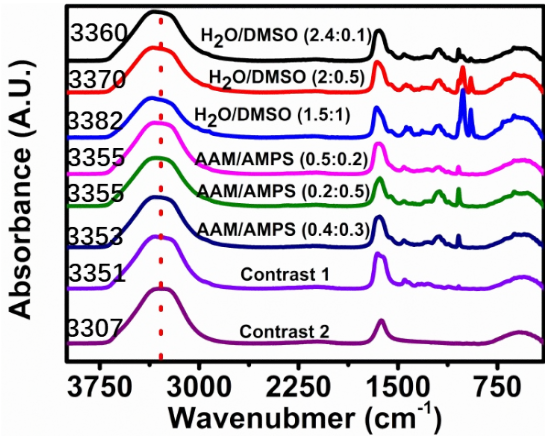

Fig. S1. FTIR spectra of the polymer hydrogels with different ratios of H_2O/DMSO and AAM/AMPS, (contrast 1 is the PAAM hydrogel, contrast 2 is the deionized water).

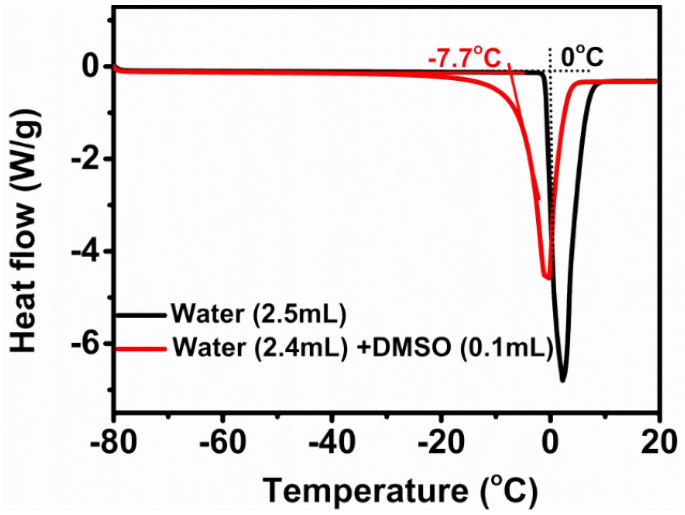

Fig. S2. DSC curves of water and the mixture of water /DMSO.

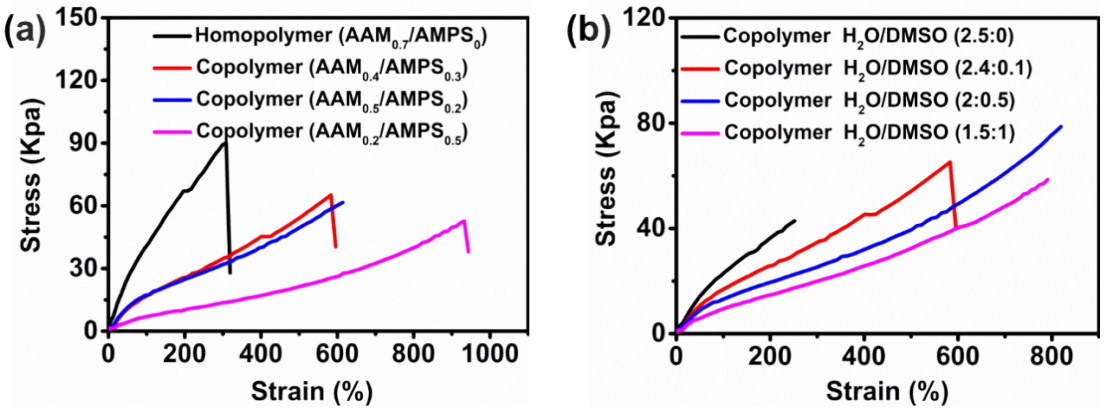

Fig. S3. Stress-strain curves of the hydrogels with different content of H_2O/DMSO and AAM/AMPS.

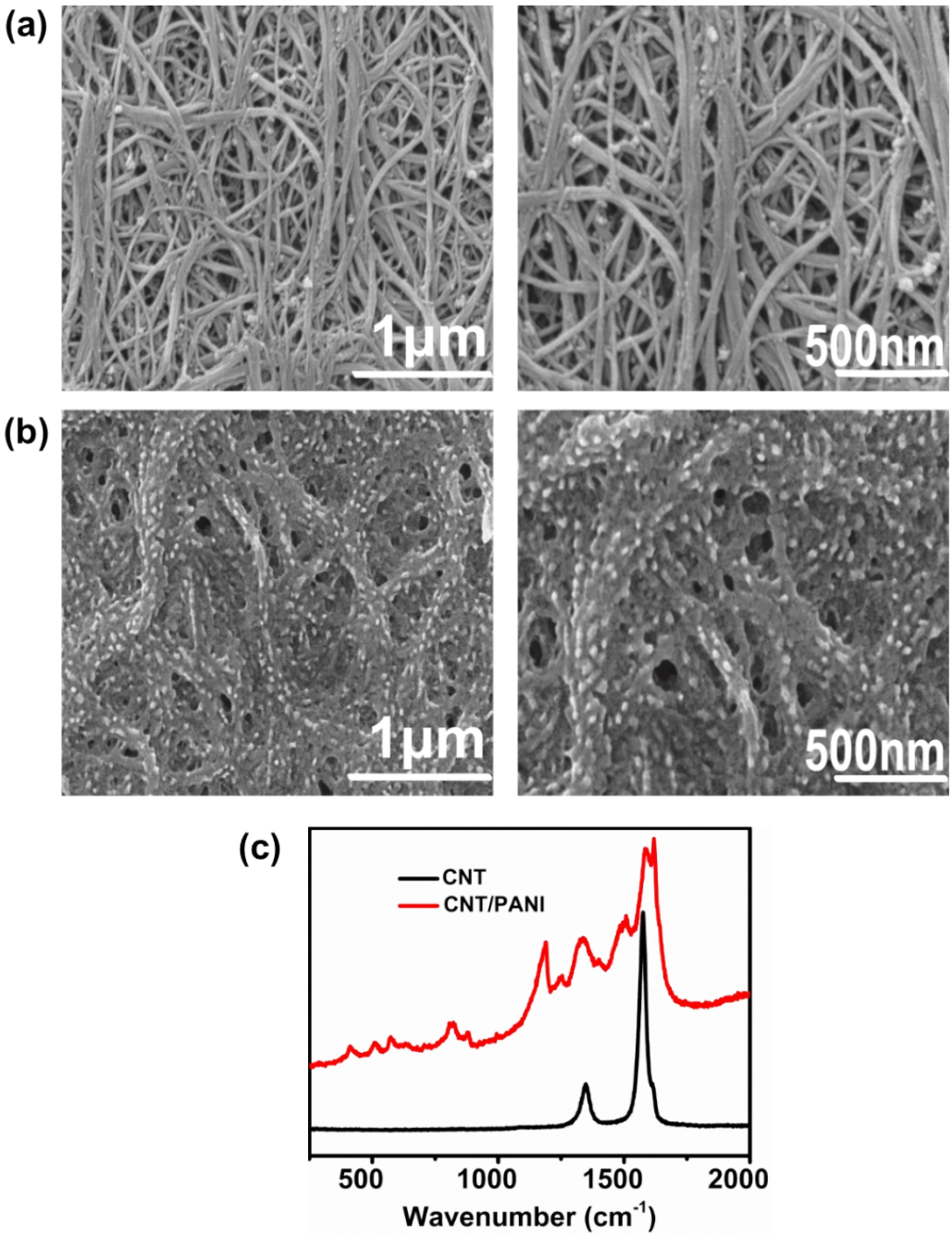

Fig. S4. (a) SEM images of the pure CNT films, (b) SEM images of the CNT/PANI composite films, (c) Raman spectrum of pure CNT films and CNT/PANI composite films.

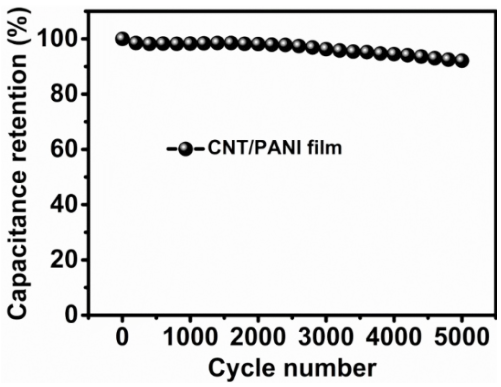

Fig. S5 Cycling stability of the supercapacitors based on P($AMPS_{0.3}$-co-$AAM_{0.4}$) hydrogel at 10 mA/cm^2.

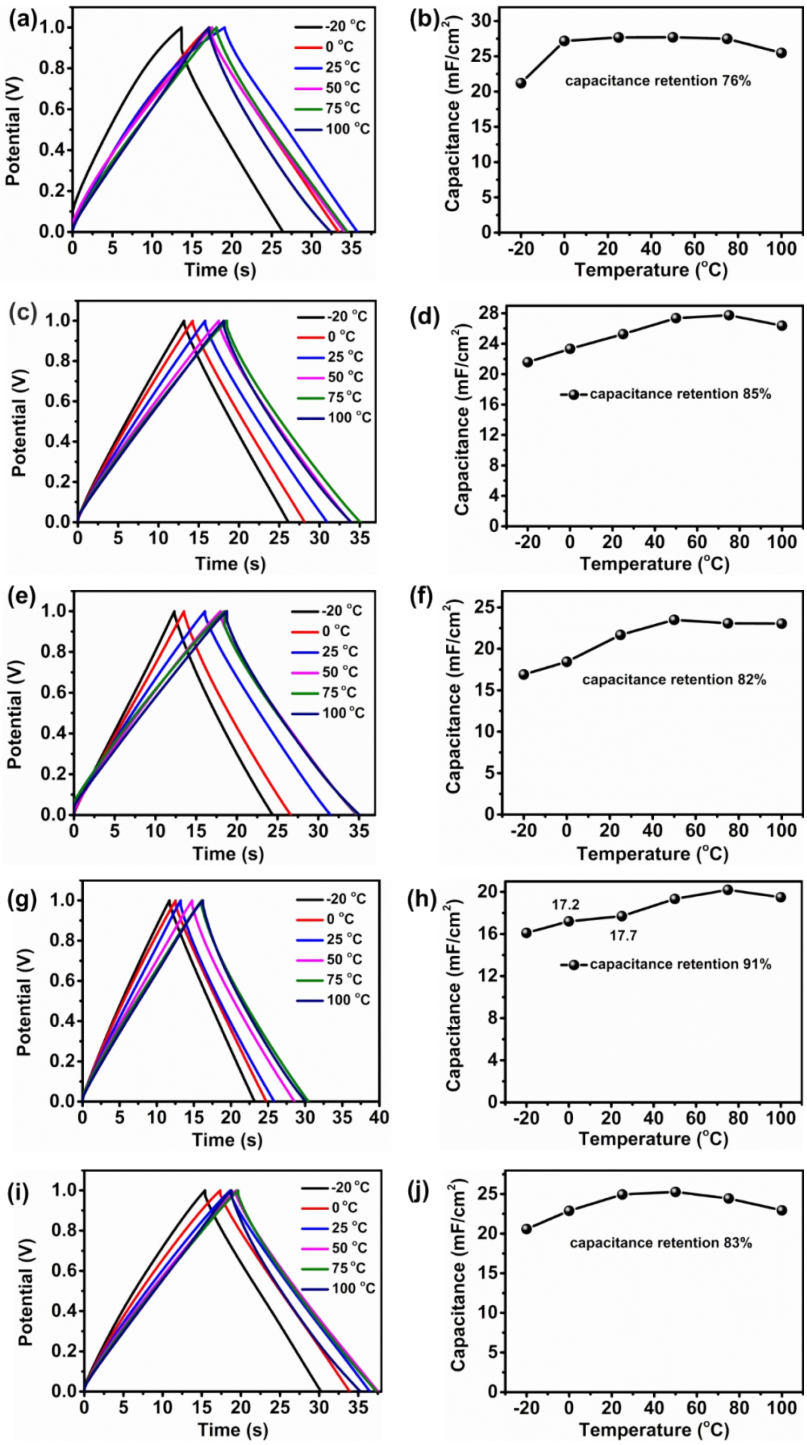

Fig. S6. The GCD curves and corresponding capacitance retention of the supercapacitors based on the P(AMPSx-co-AAM$_y$) hydrogel with different mass ratio of AAM/AMPS, (a, b) AAM=0.7 g, AMPS=0 g, without use of DMSO, (c, d) AAM=0.7 g, AMPS=0 g, (e, f) AAM=0.2 g, AMPS=0.5 g, (g, h) AAM=0.4 g, AMPS=0.3 g, (i, j) AAM=0.5 g, AMPS=0.2 g. (c-j) H_2O=2.4mL, DMSO=0.1mL. The supercapacitors were fabricated by using bare carbon nanotube film electrodes.

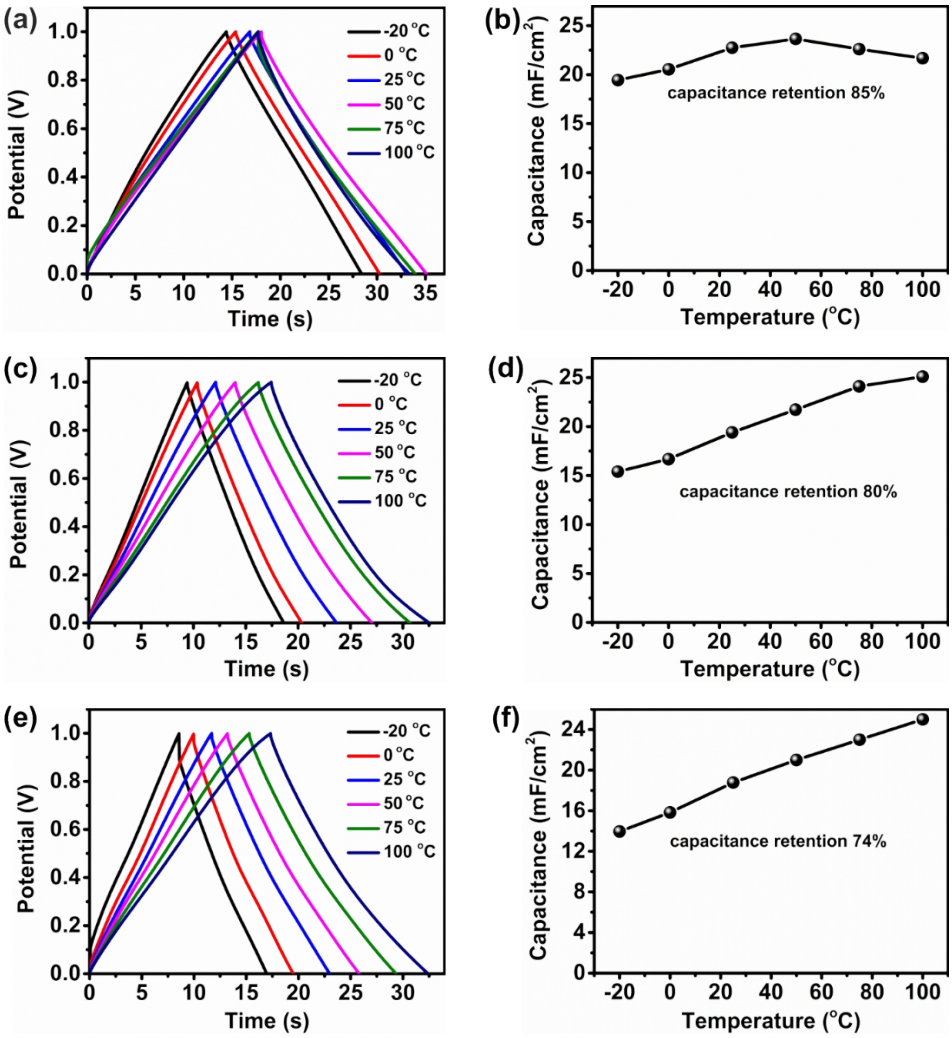

Fig. S7. The GCD curves and corresponding capacitance retention of the supercapacitors based on the P($AMPS_{0.3}$-co-$AAM_{0.4}$) hydrogel with different volume ratio of H_2O/DMSO, 2.5:0 (a, b), 4:1 (c, d), 3:2 (e, f). Bare carbon nanotube films were used as electrodes to fabricated supercapacitors.

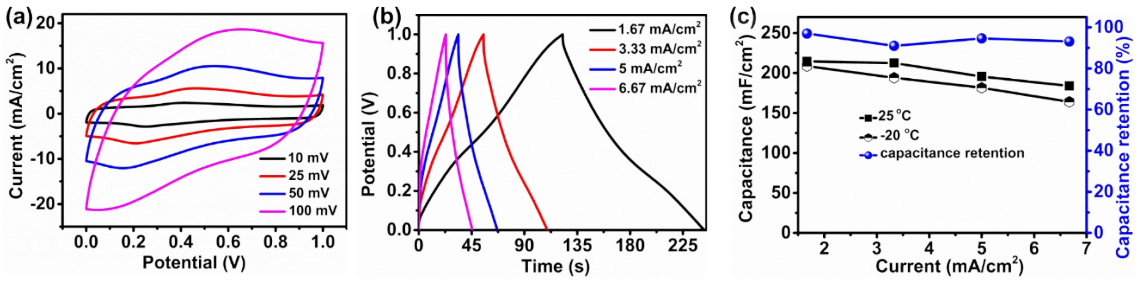

Fig. S8. (a, b) CV and GCD curves of supercapacitors based on the polymer hydrogel electrolyte at room temperature at -20 °C. (c) Specific capacitances and capacitance retention of the devices at a current density of 3.33 mA/cm^2 at 25 °C and -20 °C.

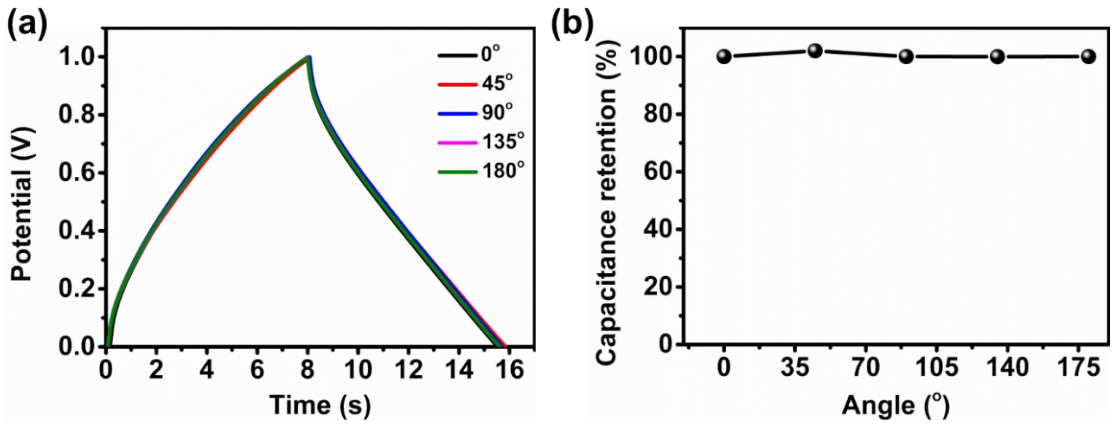

Fig. S9. Flexibility of the supercapacitor based on P(AMPS$_{0.3}$-co-AAM$_{0.4}$) hydrogel at -20 °C. (a,b) The GCD curves (a) and capacitance retention (b) of the device under different bending angles. Bare carbon nanotube films were used as the electrodes.