Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Soft, flexible and self-healable supramolecular conducting polymer-based hydrogel electrodes for flexible supercapacitors

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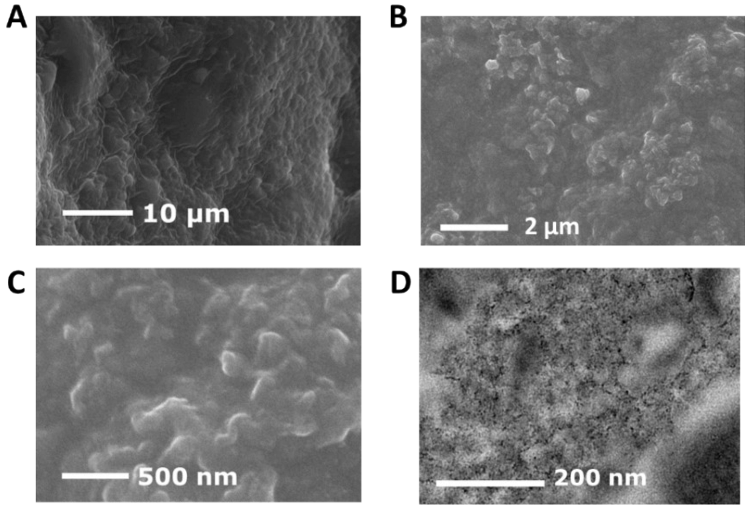

Figure S1. SEM images (A, B, and C) and TEM image (D)of freeze-dried poly(EDOT-*co*-(Th-*g*-PAA)-*co*-ThBA)−PVA hydrogel.

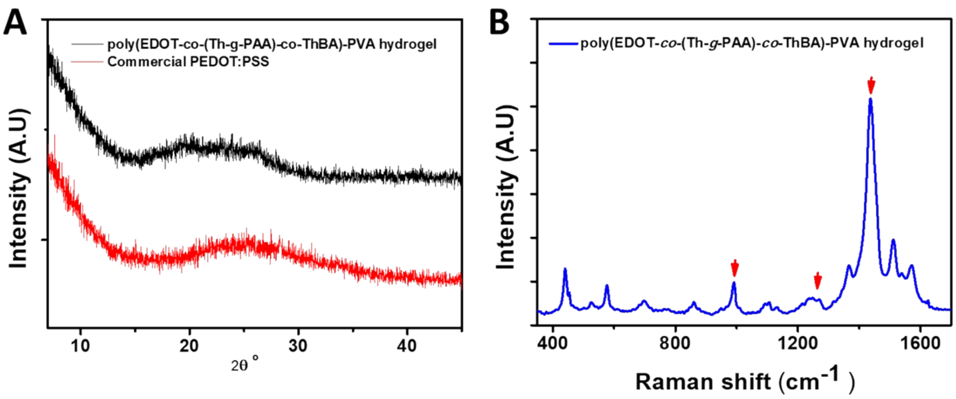

Figure S2 (A) XRD of dried poly(EDOT-*co*-(Th-*g*-PAA)-*co*-ThBA)−PVA hydrogel and commercial PEDOT:PSS. (B) Raman spectra of dried poly(EDOT-*co*-(Th-*g*-PAA)-*co*-ThBA)−PVA hydrogel.

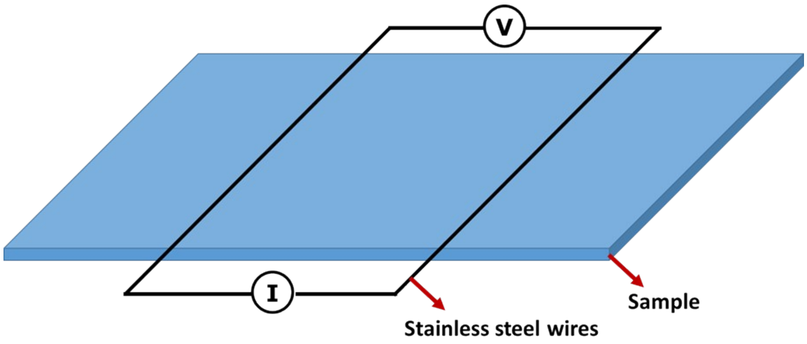

Figure S3 Setup for conductivity measurement. The width, thickness and length of measured hydrogels were 1 cm, 2 mm and 1 cm.

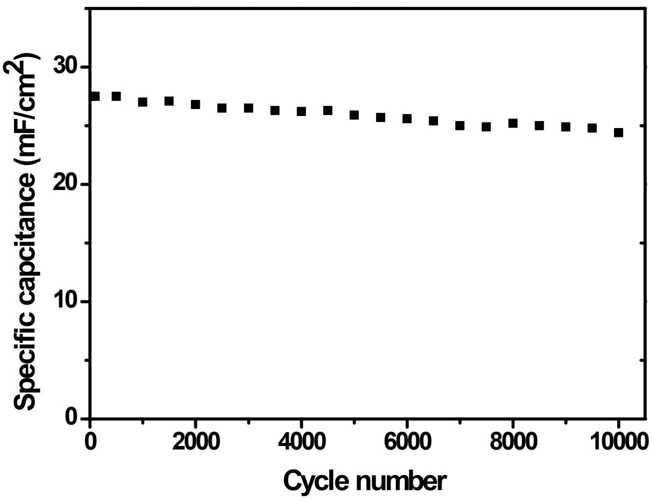

Figure S4. Specific capacitance, obtained from GCD measurements, with a current density of 10 mA/cm^2 over 10000 charge-discharge cycles.

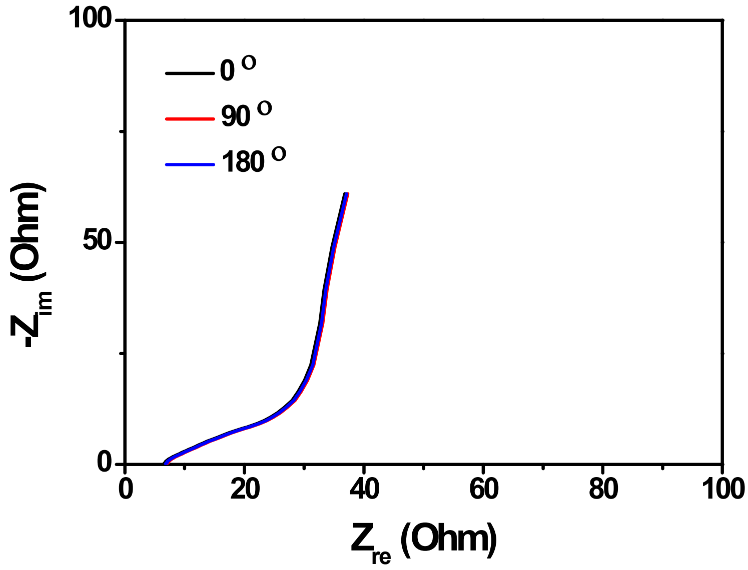

Figure S5 EIS spectra in form of Nyquist plot of poly(EDOT-*co*-(Th-*g*-PAA)-*co*-ThBA)-PVA hydrogel-based supercapacitor at different bending angles.

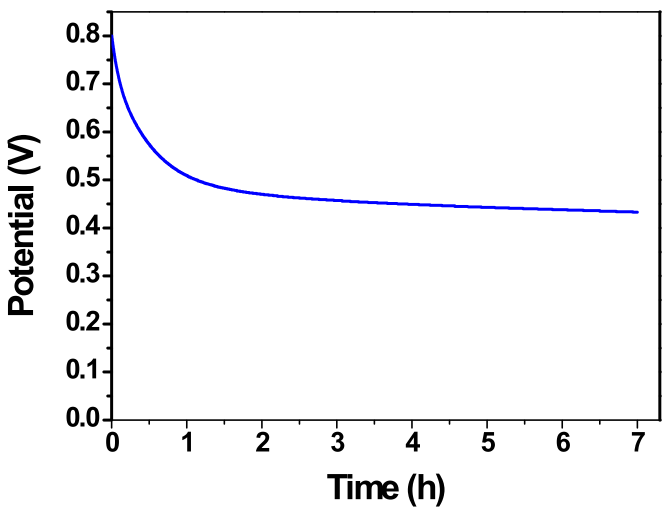

Figure S6 Self-discharge test of poly(EDOT-*co*-(Th-*g*-PAA)-*co*-ThBA)-PVA hydrogel based supercapacitor.

Table S1 The comparison of the poly(EDOT-*co*-(Th-*g*-PAA)-*co*-ThBA)-PVA hydrogel based flexible supercapacitor with other conductive polymer-based flexible supercapacitors.

Conducting polymer-based supercapacitor	**Specific capacitance**	**Energy density**	**Stability**	**ref**
EDOT-PVA hydrogel-based supercapacitor	181 F/g at 0.5 A/g	24 W h/kg	100% capacitance retention after 15000 charge–discharge cycles	[1]
PEDOT-PVA hydrogel cross-linked by boronate bonds	66 mF/cm^2 (75.9 F/g) at 0.29 A/g	15.2 W h/kg	89% capacitance retention after 1000 charge–discharge cycles	[2]
PANI-PVA hydrogel cross-linked by boronate bonds	306 mF/cm^2 at 0.25A/g	13.6 W h/kg	90% capacitance retention after 1000 charge–discharge cycles	[3]
PANI-PVA hydrogel prepared from five freeze–thaw cycles	420 mF/cm^2 (210 F/g) at 0.25 A/g	18.7 W h/kg	100% capacitance retention after 1000 charge–discharge cycles	[4]
PPy /aligned polyacrylamide aerogel (APA)	831 mF/cm^2	73.8 μW h /cm^2	86.5% capacitance retention after 1000 charge–discharge cycles	[5]
PPy-PVA all-in-one supercapacitor	13.06 F/cm^3	1160.9 μW h/cm^3	86.3% capacitance retention after 10,000 charge–discharge cycles.	[6]
PPy layers modified boron cross-linked PVA/KCl hydrogel	224 mF/cm^2	20 μW h /cm^2	92% capacitance retention after 2000 charge–discharge cycles	[7]
PPy/GO nanocomposites	152 mF/cm^2 at 10 mV/s	12.9 μW h /cm^2	96.4% capacitance retention after 5000 charge–discharge cycles, as 88.3% for 10,000 cycles	[8]
poly(EDOT-*co*-(Th-*g*-PAA)-*co*-ThBA)-PVA hydrogel based supercapacitor	(222.32 ± 7.59) mF/cm^2 at 10 mV/s	19.8 μW h/cm^2	95.8% capacitance retention after 1,000 charge-discharge cycles, while 89.6% after 10,000 cycles	This work

Reference:

1. H. Lu, Y. Li, Q. Chen, L. Chen, N. Zhang and M. Ma, ACS Appl. Energy Mater., 2019, 2, 8163-8172.
2. Q. Chen, H. Lu, F. Chen, L. Chen, N. Zhang and M. Ma, ACS Appl. Energy Mater., 2018, 1, 4261-4268.
3. W. Li, F. Gao, X. Wang, N. Zhang and M. Ma, Angew. Chem. Int. Ed., 2016, 128, 9342-9347.
4. W. Li, H. Lu, N. Zhang and M. Ma, ACS Appl. Mater. Interfaces., 2017, 9, 20142-20149.
5. Y. Zhao, Y. Alsaid, B. Yao, Y. Zhang, B. Zhang, N. Bhuskute, S. Wu and X. He, Adv. Funct. Mater., 2020, 30, 1909133.
6. L. Zang, Q. Liu, J. Qiu, C. Yang, C. Wei, C. Liu and L. Lao, ACS Appl. Mater. Interfaces., 2017, 9, 33941-33947.
7. K. Sun, E. Feng, G. Zhao, H. Peng, G. Wei, Y. Lv and G. Ma, ACS Sustain. Chem. Eng., 2019, 7, 165-173.
8. H. Zhou, G. Han, Y. Xiao, Y. Chang and H.-J. Zhai, J. Power Sources, 2014, 263, 259-267.