Supporting information

High-ampacity conductive polymer microfibers as fast response wearable heaters and electromechanical actuators

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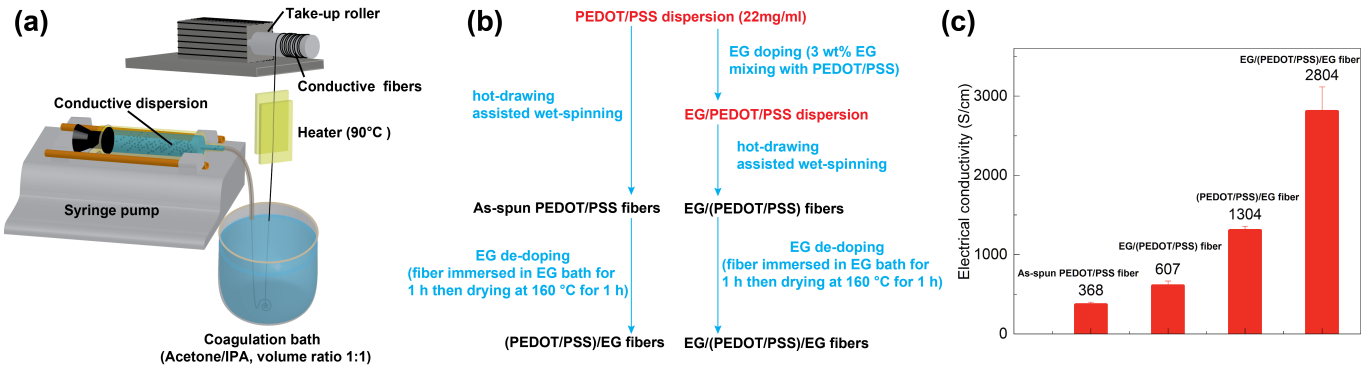

Fig. S1 Improving the conductivity of PEDOT/PSS fibers. (a) A schematic of the wet-spinning set-up with the vertical hot-drawing apparatus used in this study. The draw ratio was controlled to 3:1. (b) A schematic of strategies to improve the conductivity of PEDOT/PSS fibers. (c) Average electrical conductivity of different PEDOT/PSS fibers by using the strategies in (b).

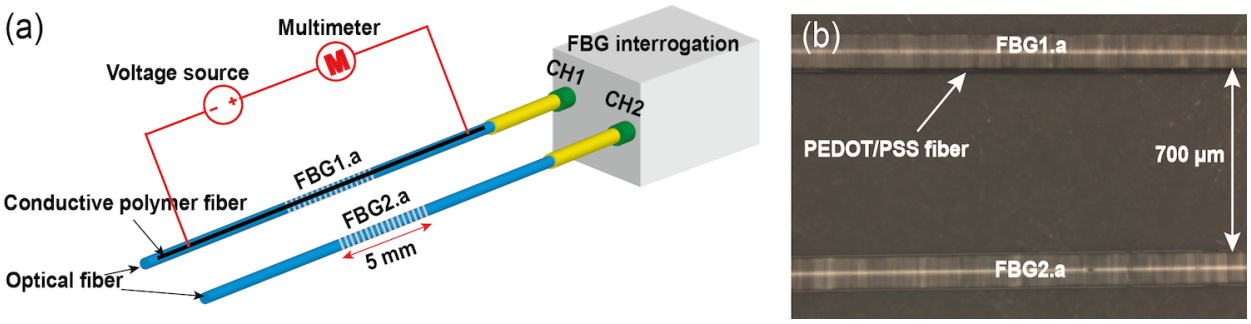

Fig. S2 Temperature sensing by FBGs. (a) Experimental setup for the temperature measurement of the polymer fiber using FBGs. (b) Optical image shows the position of optical fibers and the PEDOT/PSS fiber during the temperature measurement. The distance between two FBGs is 700 μm.

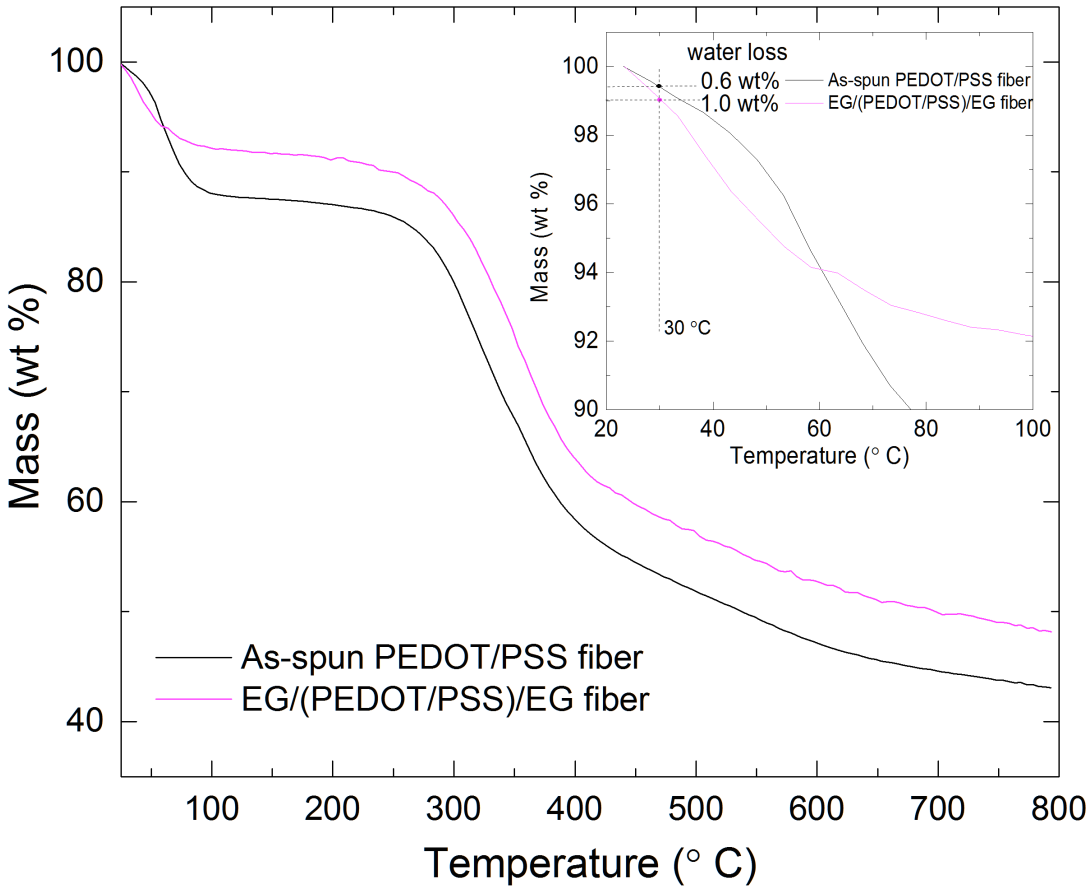

Fig. S3 TG curves of the as-spun PEDOT/PSS fiber and the EG/(PEDOT/PSS)/EG fiber. Inset is the TG curve from 20 to 100 °C.

Figure S3 shows that the first stage of weight loss up to 200 °C is from the loss of water. The decomposition of PSS starts from 265 °C ends at 320 °C with a weight loss of 25 wt%. This is due to the decomposition of PSS as the sulfonate groups disassociate from styrene.[1] This decomposition is followed by another decomposition of PEDOT in the range between 350 and 600 °C with a weight loss of 10 wt%, which is due to the rupture of the polymer back bone.[1,2] It is worth noting that the residual is over 40 % around 800 °C.

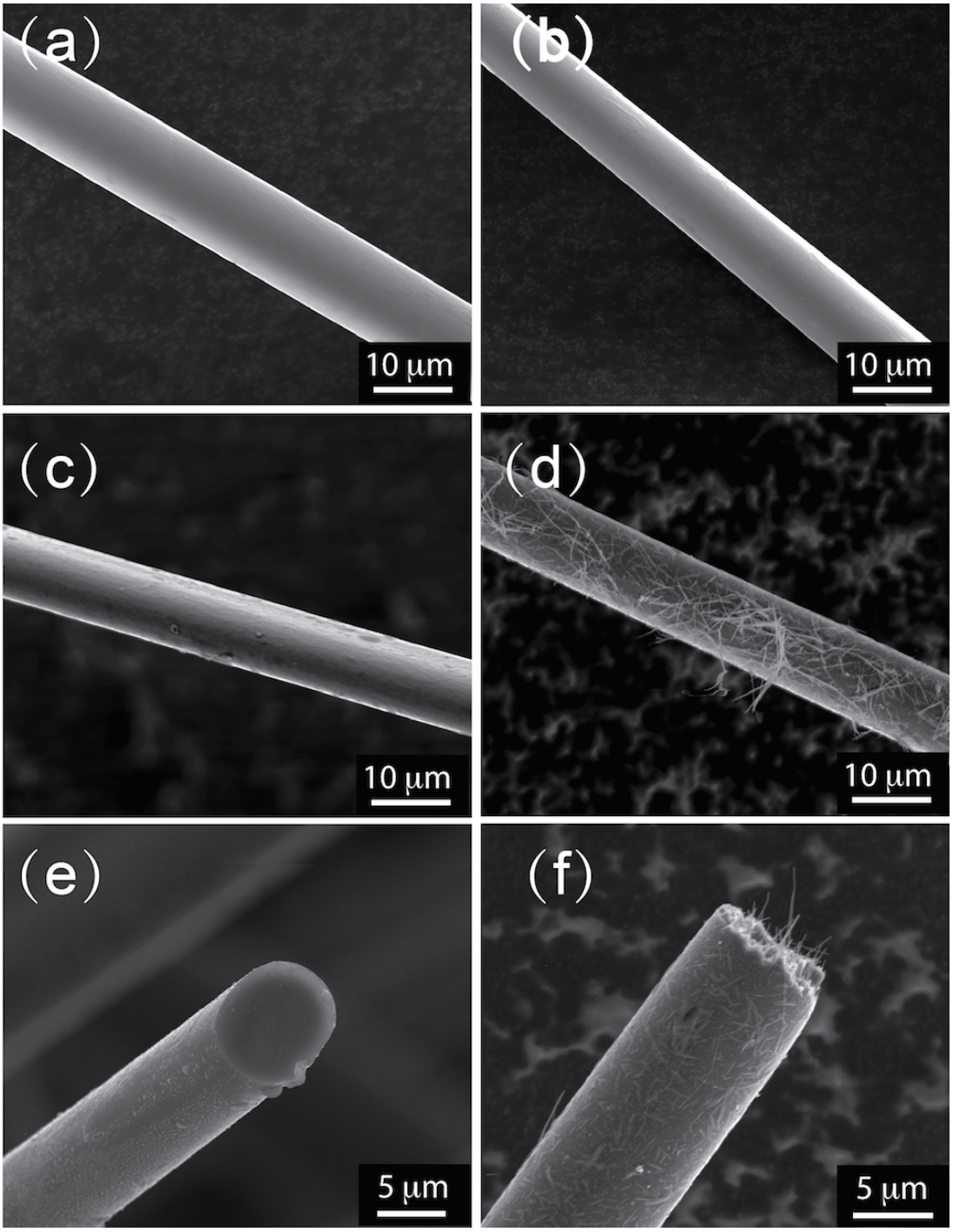

Fig. S4 SEM images of the conductive polymer microfibers before and after TG analysis (25 to 800 °C) in N_2. (a) As-spun PEDOT/PSS fiber, (b) EG/(PEDOT/PSS)/EG fiber, (c) As-spun PEDOT/PSS fiber after TG. (d) EG/(PEDOT/PSS)/EG fiber after TG. (e) and (f) cross section images of the as-spun PEDOT/PSS fiber and the EG/(PEDOT/PSS)/EG fiber after TG.

Table S1 Relative element quantification in the fibers by the energy dispersive x-ray spectroscopy (EDS).

Sample	Element atomic ratio (At %) C	O	S	Na
As-spun PEDOT/PSS fibers	75.67	12.67	11.02	0.64
EG/(PEDOT/PSS)/EG fibers	76.19	13.88	9.14	0.79
As-spun PEDOT/PSS fibers-800°C	89.70	6.61	2.43	1.27
EG/(PEDOT/PSS)/EG fibers-800°C	88.48	7.02	2.41	2.10%

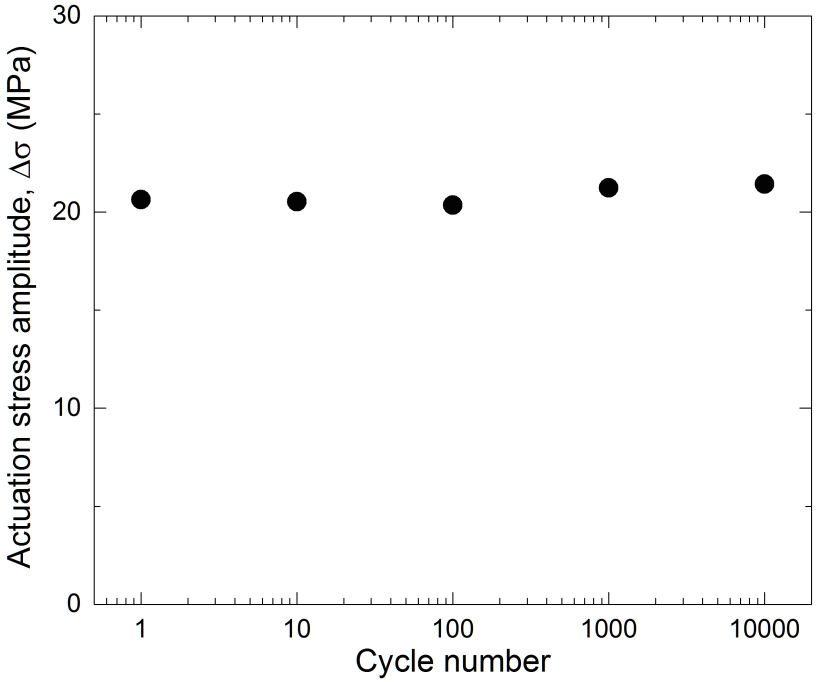

Fig. S5 Actuation stress amplitude of the EG/(PEDOT/PSS)/EG fiber under the applied 1 Hz square wave voltage (0-5V) at different cycle numbers (1, 10, 100, 1000 and 10000).

References

1 D. Antiohos, G. Folkes, P. Sherrell, S. Ashraf, G. Wallace, P. Aitchison, A. Harris, J. Chen and A. Minett, *J Mater Chem*, 2011, **21**, 15987–15994.

2 J. Zhou, I. Ventura and G. Lubineau, *Ind Eng Chem Res*, 2014, **53**, 3539–3549.