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.
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.\textsuperscript{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.\textsuperscript{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 N₂. (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).

<table>
<thead>
<tr>
<th>Sample</th>
<th>C</th>
<th>O</th>
<th>S</th>
<th>Na</th>
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<tbody>
<tr>
<td>As-spun PEDOT/PSS fibers</td>
<td>75.67</td>
<td>12.67</td>
<td>11.02</td>
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<td>EG/(PEDOT/PSS)/EG fibers</td>
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<td>As-spun PEDOT/PSS fibers-800°C</td>
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<td>EG/(PEDOT/PSS)/EG fibers-800°C</td>
<td>88.48</td>
<td>7.02</td>
<td>2.41</td>
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</table>

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
