## **Supporting Information**

## Surface Structure Engineering for Bionic Fiber-Based Sensors toward Linear,

## **Tunable and Multifunctional Sensing**

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Figure S1 The stress-strain curves of the PS and TPU.



Figure S2 The tensile process of the oritended coaxial fiber membrane.



Figure S3 The illustration of ASF sensor.



Figure S4 Statistic analysis of the crack number (a, ASF-30) and segment length of PS (b, ASF-50; c, ASF-100, respectively).



Figure S5 The fracture surfces by SEM of the coaxial fiber (a) and corresponding EDS mapping image of Ag element (b).



Figure S6 The initial resistance of the four samples.



Figure S7 The element content of segmental fiber a) before and b) after Ag loading.



Figure S8 SEM images of the segmental fiber after Ag loading, a) ASF-30, b) ASF-50, c) ASF-100, respectively, indicate an uniform loading and thus ensure the good and stable conductivity.



Figure S9 Relative resistance response for the control fiber-based sensor.



Figure S10 Sensing performance of the ASFS-100 sensor measured via parallel to and perpendicular to the fiber orientation direction.



Figure S11 The sensing performance of ASFS-100 with different initial resistance. Sensors with different initial resistances (i.e. different loading amount of Ag) have certain differences in sensing performance. As the initial resistance decreases (i.e. the loading amount of Ag decreases), the sensor performance will decrease to varying degrees.



Figure S12 The the resistance change of 1000 cycles under strains of 1 % (a) and 18 % (b).



Figure S13 Strain/static force-time curves about the sensor mat. a) Ramp stress 2 MPa/min of loading and unloading 0.2 MPa. b) Ramp stress 4 MPa/min of loading and unloading 0.2 MPa. c) Ramp stress 4 MPa/min of loading and unloading 0.2 MPa for 11 cycles. d) Ramp stress 4 MPa/min of loading and unloading 0.1 MPa for 11 cycles.



Figure S14 a) strain-stress curves of the ASFS-100. b) Strain/static force-time curves for clarifying the fast response. c) Cyclic sensing performance at 1 % strain under a high strain speed of 0.02 s-1.



Figure S15 The logarithmic strain contours under 10 % strain, a)  $C_{PU}$  /  $S_{PU}$  system, b)  $C_{PU}$  /  $S_{PS}$  system, respectively, indicate the 2 times of intensity of strain concentration in  $C_{PU}$  /  $S_{PS}$  system than  $C_{PU}$  /  $S_{PU}$  system.



Figure S16 The device of vapour sensing test.