Supporting Information

TiO_2-modified porous carbon fibers interlayer for long-cycling and high-rate lithium-sulfur batteries

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1. Experimental Section

1.1 Preparation of TiO_2-PCF films

Facial tissue was cut into small pieces and annealed in a tube furnace at 800 °C, 1000 °C, or 1200 °C for 2 h under an argon atmosphere. The heating rate was set at 3 °C min^{-1}. After cooling to room temperature, free-standing TiO_2-PCF films were obtained.

1.2 Preparation of sulfur-carbon cathode

The sulfur-carbon composite was prepared by blending sulfur and carbon black at a mass ratio of 3:1, followed by heating at 155 °C for 12 h. The composite was then mixed with acetylene black and polyvinylidene fluoride at a mass ratio of 7:2:1 and dispersed in N-methyl-2-pyrrolidone to form a uniform slurry. The slurry was evenly coated onto carbon-coated aluminum foil and dried in a vacuum oven at 60 °C for 12 h. The working electrode was then punched into disks with a diameter of 12 mm for battery assembly.

1.3 Battery assembly

CR2032 coin cells were assembled in an argon-filled glove box with moisture and oxygen levels maintained below 0.1 ppm. A lithium metal sheet (14 mm in diameter) served as the counter electrode, while PP was used as the separator. The TiO_2-PCF interlayer, also 14 mm in diameter, was placed between the separator and the cathode. The electrolyte consisted of 1 wt% $LiNO_3$ and 1 M LiTFSI dissolved in a 1:1 volume ratio of 1,3-dioxolane and dimethoxyethane.

1.4 Material characterizations

XRD patterns were recorded using a Bruker D8 Advance diffractometer with Cu Kα radiation. SEM images were captured using a Gemini SEM 300 at an accelerating voltage of 10 kV. Contact angle measurements were performed on a KRUSS DSA25 apparatus. XPS analysis was conducted using an ESCALAB 250XI system.

2. Supporting figures

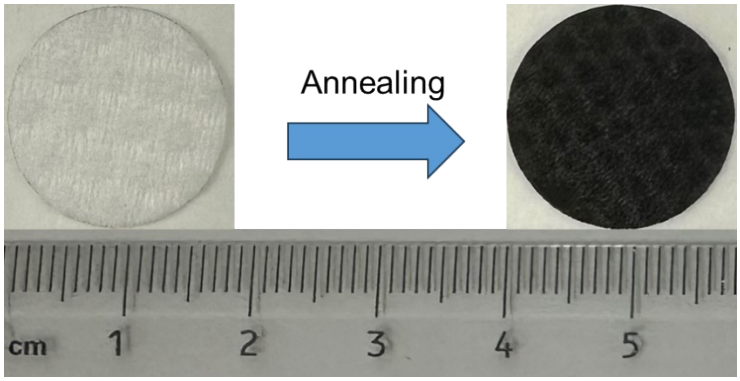

Figure S1. Photographs showing the facial tissue before and after annealing.

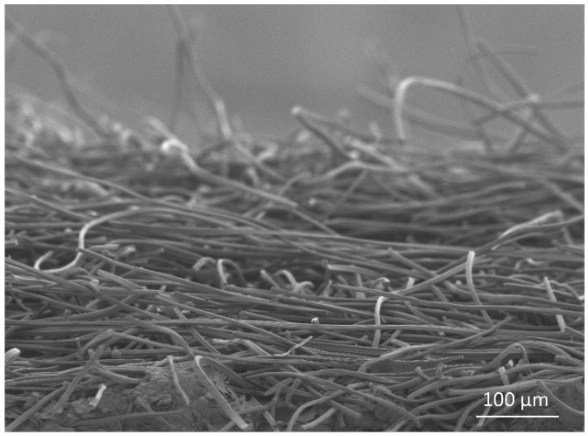

Figure S2. SEM images of TiO_2-PCF prepared under the temperatures of 1000 ^{o}C.

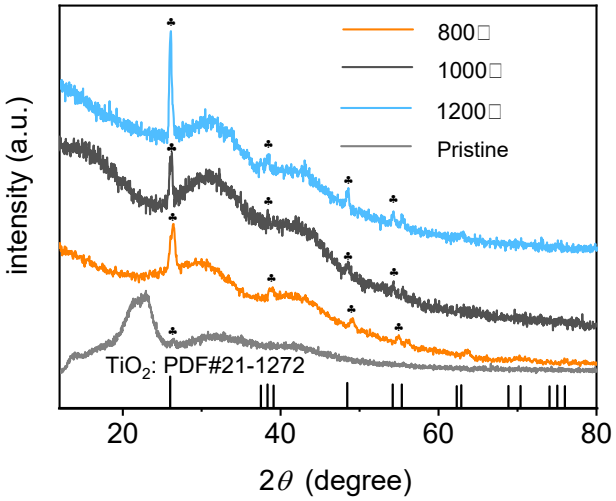

Figure S3. XRD characterization of the facial tissues before and after carbonization under different temperatures.

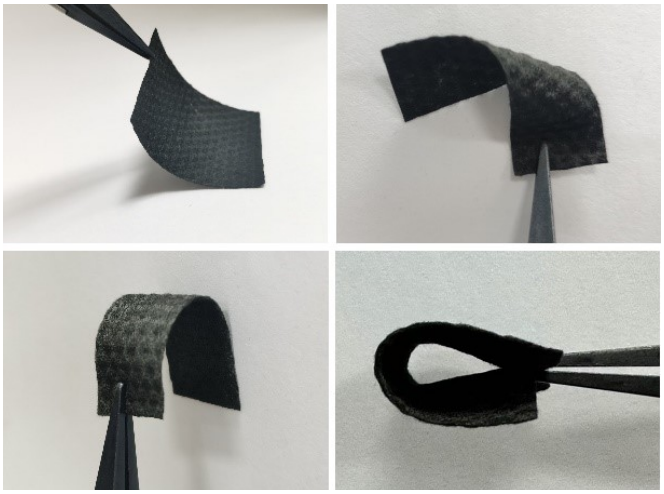

Figure S4. Photographs of the TiO_2-PCF film under different bending states.

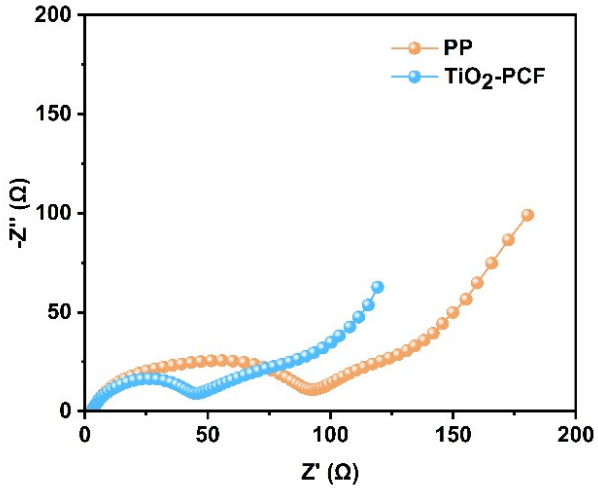

Figure S5. Electrochemical impedance spectroscopy of the cells assembled with PP separator and TiO_2-PCF interlayer.

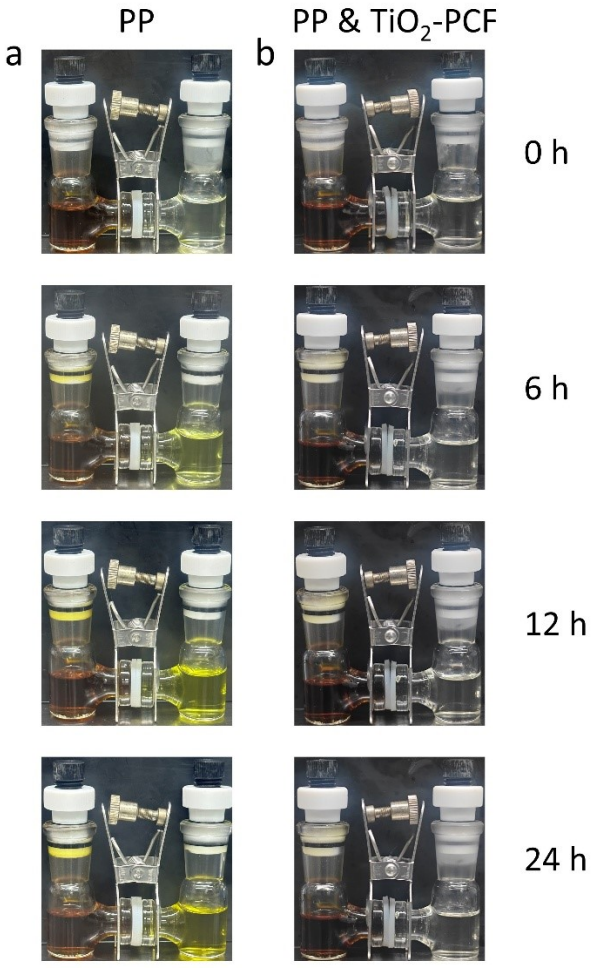

Figure S6. Observation of Li_2S_6 diffusion across (a) PP separator and (b) TiO_2-PCF interlayer clamped in a H-cell.

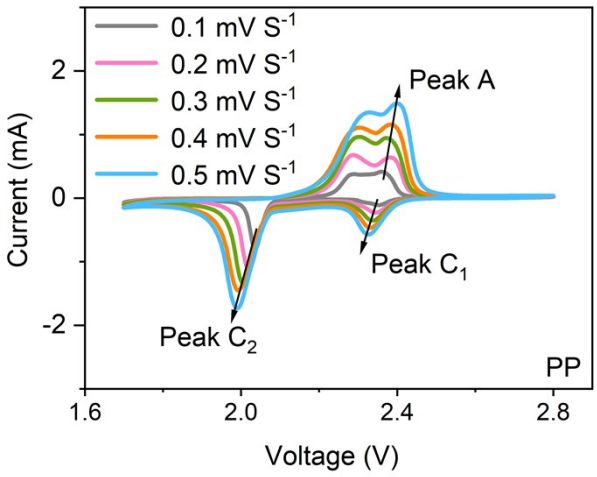

Figure S7. CV profiles of the cell with PP separator at different scan rates ranging from 0.1 to 0.5 mV s^{-1}.

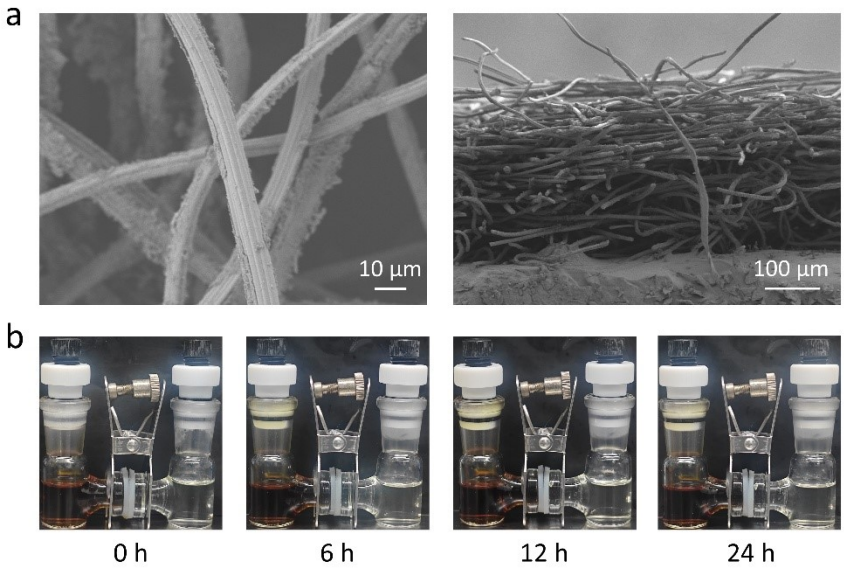

Figure S8. (a) SEM images of the TiO_2-PCF interlayer after cycling. (b) Observation of Li_2S_6 diffusion across cycled TiO_2-PCF interlayer.

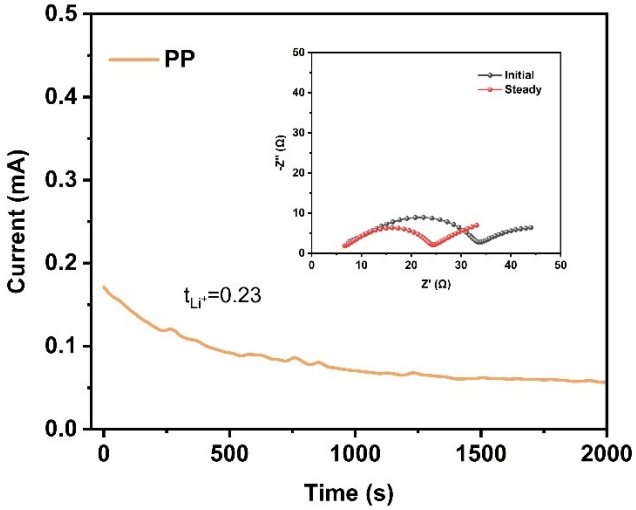

Figure S9. Li^+ transference number of the cell with PP separator. The inset is the electrochemical impedance spectroscopy of the cell before and after the polarization.