Supporting Information:

Electrospun Green Fibers from Alberta Oilsands Asphaltenes

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1. Schematic illustration of Toluene/pentane purification procedure details

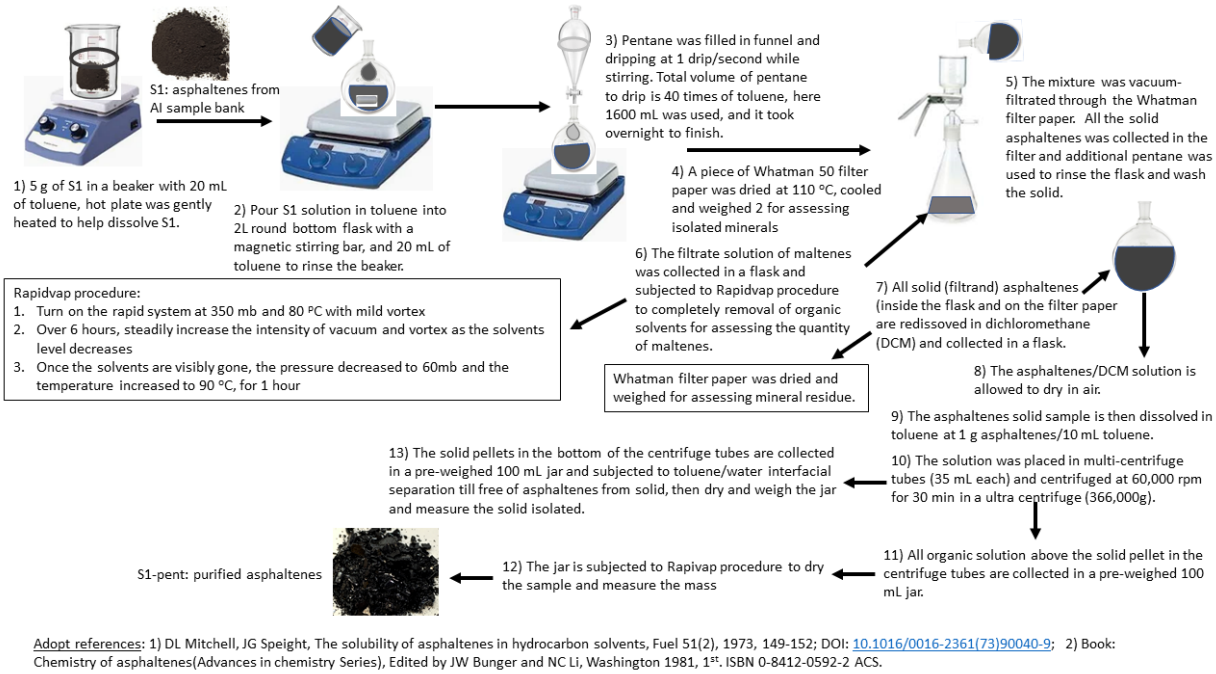


Figure S1. Schematical illustration of detailed steps of toluene/pentane purification of S1 asphaltenes to purified S1-pent asphaltenes.

Table S1. Compositions of sample S1 separated with toluene/pentane purification

Contents	**Weight (%)**	
	This work	Ref. (19)
Asphaltene	77.0	27
Maltenes	22.1	73
Mineral solids	0.9	–

2. Experimental procedures for elemental analysis

Elemental analysis was performed using a Vario EL cube with an auto-sampler. Helium was then purged through the system to remove any air and moisture. Oxygen was then flushed into the system (the sample size determines the amount of time it was purged) to initiate combustion and reduction. Once combustion and reduction were completed, Helium was purged through the system to allow the resulting carbon dioxide (CO_2), water (H_2O), nitrogen (N_2), and sulfur

dioxide SO_2) to enter their respective adsorption columns, and each adsorption column was purged separately to determine the actual concentration of the adsorbate using the thermal conductivity detector. The concentration was determined using an internal calibration that was corrected by using a calibration standard (most commonly Sulfanilamide) for a daily factor drift correction.

Table S2. Elemental analyses of as-received S1 (powder), purified S1-pent (powder) and S1-fiber (Tol) from toluene, S1-fiber (Xyl) from xylene, and S1-pent-fiber (Xyl) from xylene.

Samples	**Elemental content (wt%)**			
	C	H	S	N
S1	81.7	8.2	7.8	2.3
S1-pent	82.6	8.0	8.3	1.1
S1-fiber (tol)	82.6	8.5	7.9	1.1
S1-fiber (xyl)	82.7	8.4	7.8	1.1
S1-pent-fiber (xyl)	82.3	8.1	8.4	1.2

3. Attenuated total reflectance FTIR spectra of powder S1, S1-pent and their green fibers

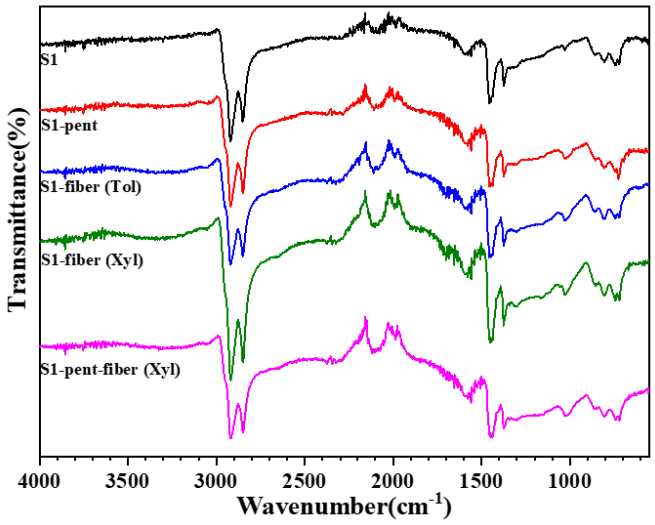


Figure S2. FTIR spectra of AOA feedstock and asphaltenes green fibres

4. Softening/melting temperature measurement of S1 and S1-pent

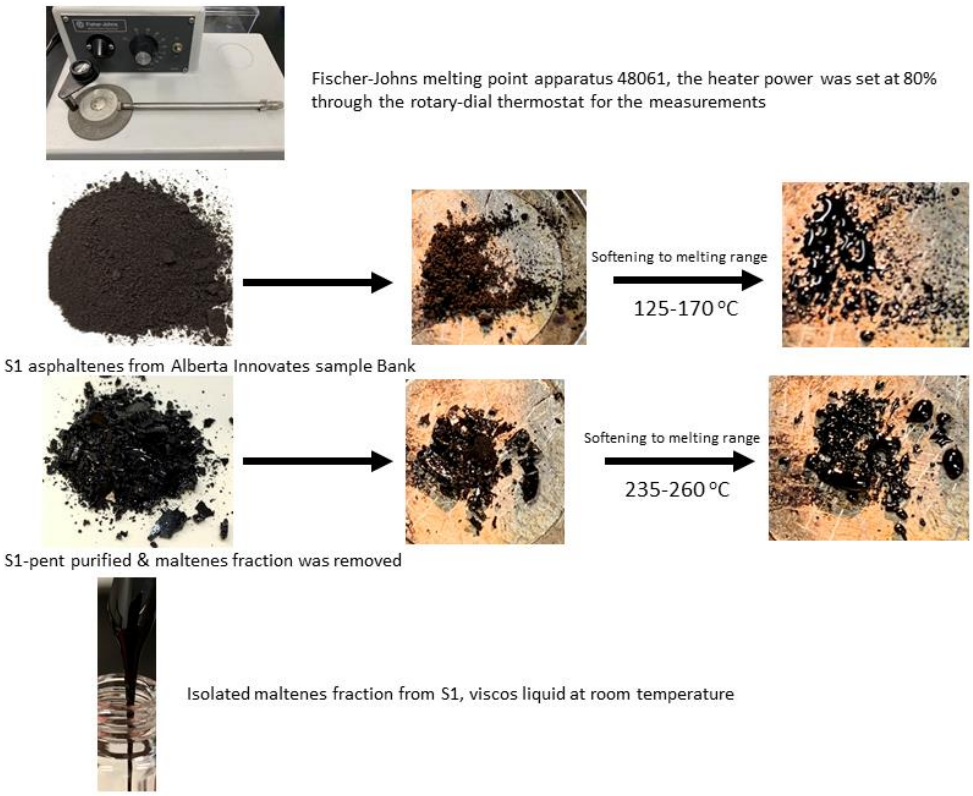


Figure S3. Softening/melting temperature measurements of S1 and S1-pent using Fischer-Johns melting point apparatus.

5. Sulfur assessment from TGA-FTIR-MS inline analysis

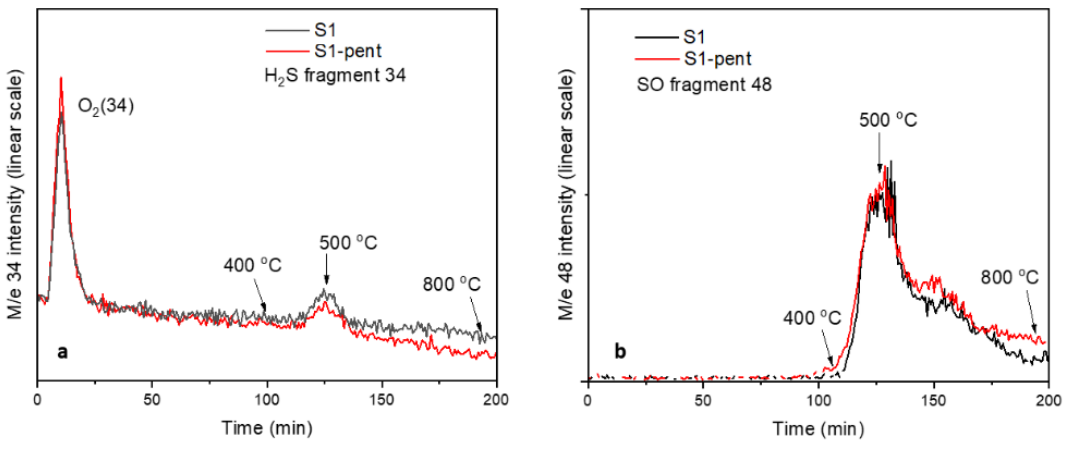


Figure S4. Evolution of sulfur species from the TGA in nitrogen purge as detected by mass spectrometry as a function of time and temperature (a) H_2S fragment of mass 34; (b) SO

fragment of mass 48. The tail end of the curves from 500 to 800 °C was a result of sulfur species condensed in the TGA furnace and/or the heated transfer line, that is slowly degrading as the temperature increased.

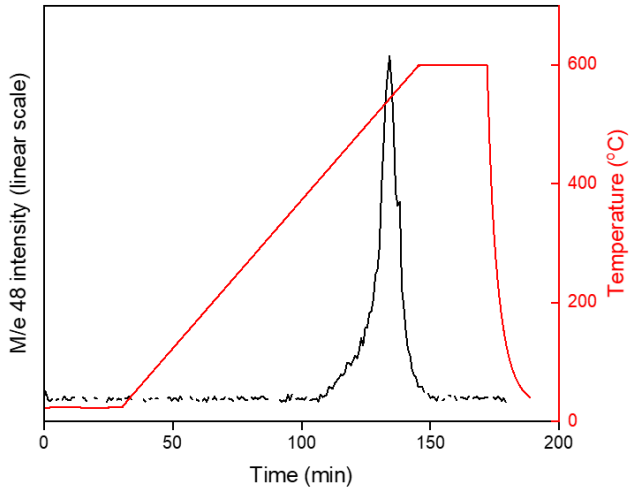


Figure S5. Evolution of sulfur species (m/e 48) of S1 from the TGA in air purge, showing a single SO peak from 400 to 600 °C with no tail end due to its fast degradation in air.

6. Trials of S1 fiber spinning according to Natarajan et al.'s procedures and further tunning of spinning conditions.

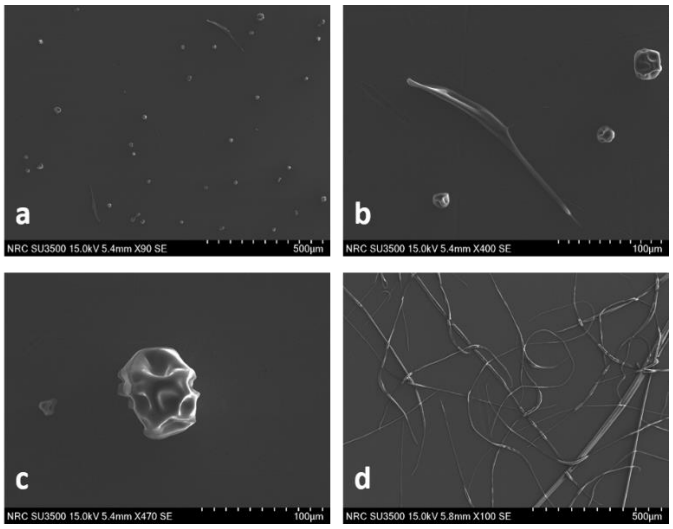


Figure S6. SEM images of the collected electrospun products of S1 with the flow rate of 1 μL/min from toluene: (a-c) 40 wt% (50 kV/m, 30 cm), (d) 50 wt% (133 kV/m, 15 cm).

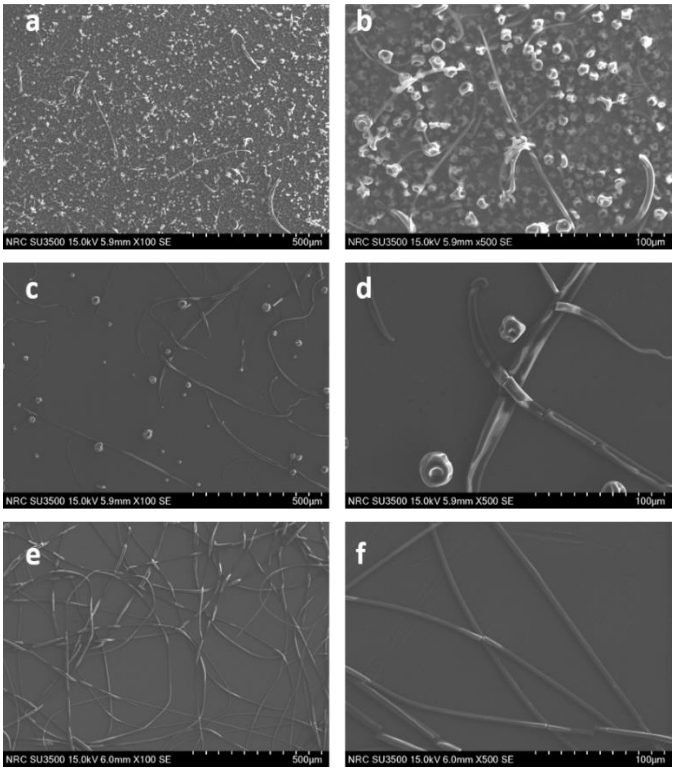


Figure S7. SEM images of the collected spun products of S1 at different concentrations: (a – b) 30 wt%; (c – d) 40 wt%; (e – f) 50 wt% in toluene, at the spinning conditions of 122 kV/m, 18 cm, and 1 μL/min.

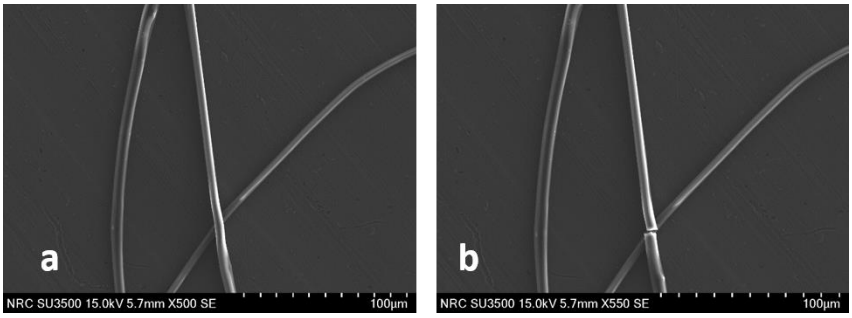


Figure S8. SEM images of electrospun 50 wt% S1 toluene solution: (a) before fracture and (b) after fracture.

7. Taylor cone formation and dry-up issue

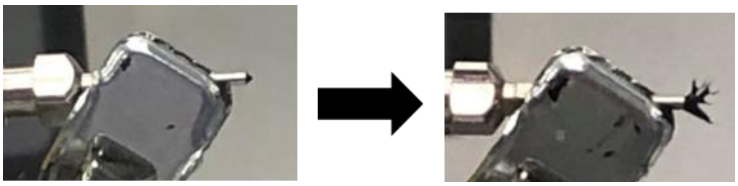


Figure S9. An example of the clogging at the apex of the spinneret.

8. Tunning of flow rate and collector rotation speed

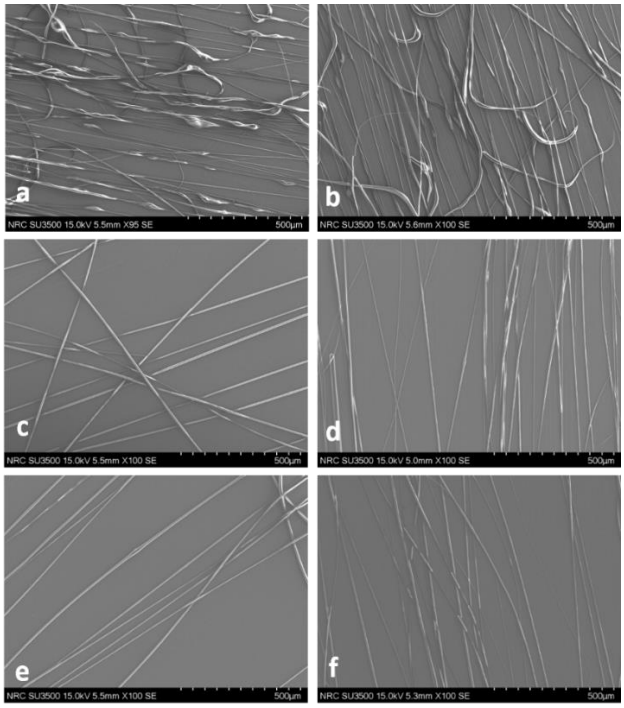


Figure S10. SEM images of S1 green fibers with the collector rotation speed at 280 rpm and flow rates of (a) 5 µL/min, (b) 3 µL/min, and (c) 1.5 µL/min; and with a fixed flow rate of 3 µL/min and collector rotation speeds of (d) 330 rpm, (e) 360 rpm, and (f) 520 rpm.

9. Proper working distance to fiber productivity with a fix feeding rate and a fix voltage

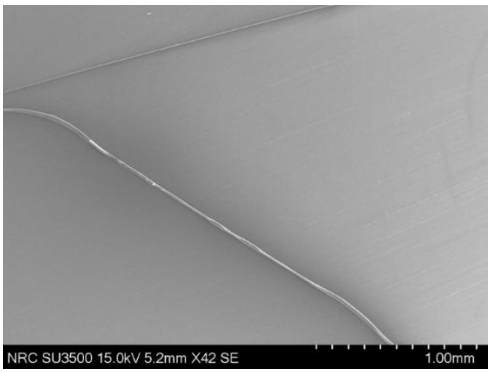


Figure S11. SEM images of S1 green fibres collected with the increased working distances at 30 cm (15 kV, 280 rpm).

10. Statistical analysis of fiber diameter changes along process conditions

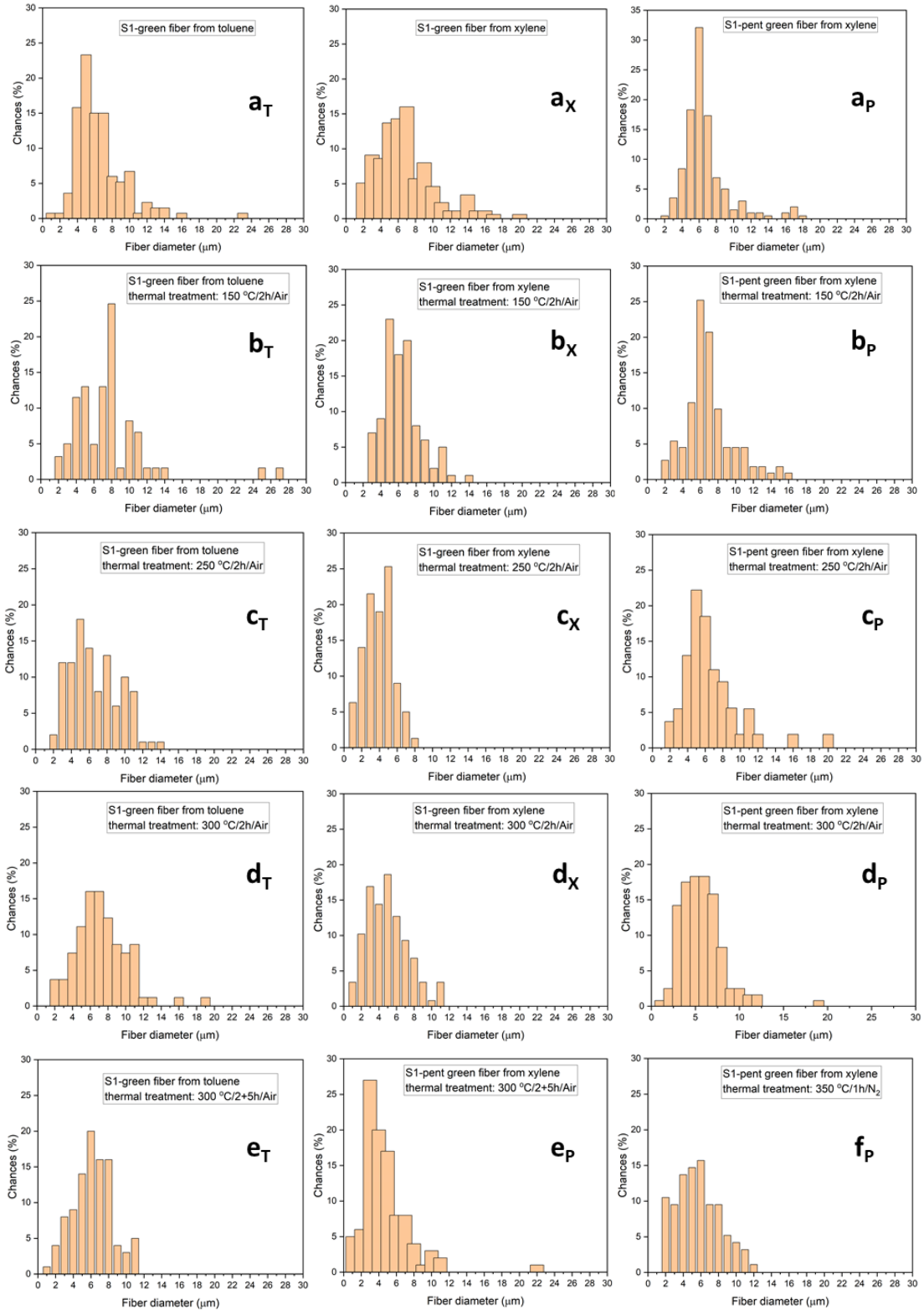


Figure S12. Statistical analysis of fiber diameter changes along the process conditions: T indicates the green fibers spun from toluene; X indicates the green fibers from xylene; P

indicates the green fibers were from S1-pent where the maltenes fraction was removed; a) green fibers, b) the green fibers were thermally treated at 150 ºC for 2h; c) at 250 ºC for 2h; d) at 300 ºC for 2h; e) at 300 ºC with additional 5 h. Both S1-green fibers from toluene and xylene started to fuse from 200 ºC and seemingly reached the high degree of network at 250 ºC, while S1-pent green fibers only had slight network until the temperature rises to 350 ºC in nitrogen after extended stabilization at 300 ºC in air.

11. fusing of a fiber mat during oxidative thermal treatment

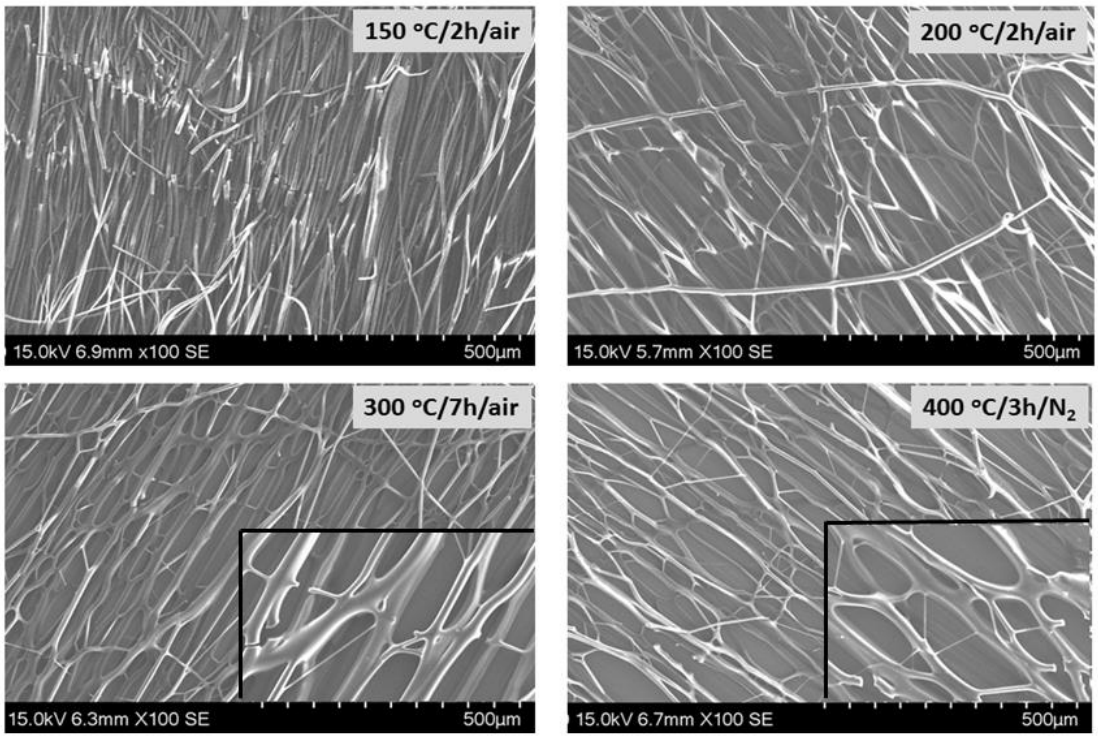
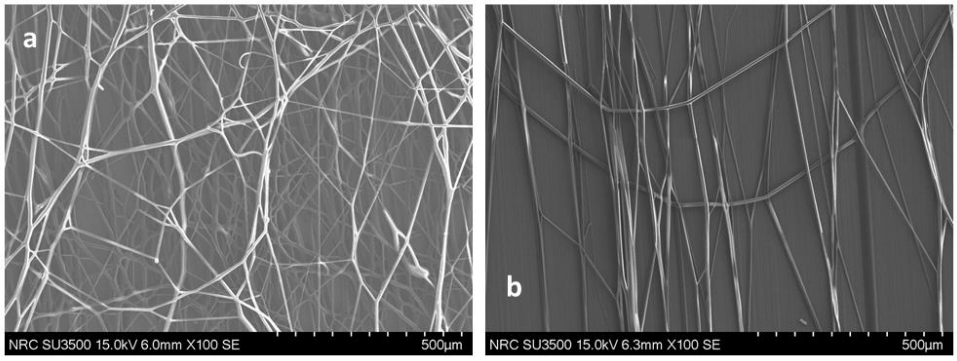


Figure S13. SEM images of thermally treated S1 green fibers from xylenes at the elevated temperatures; High magnification insets at bottom right corners for 300 °C and 400 °C.



S1-green fiber from xylene/250 °C/2h/Air S1-pent green fiber from xylene/350 °C/1h/N_2

Figure S14. a) S1-green fibers both from toluene and xylene start to fuse from 200 ºC and reached to high degree fusion at 250 ºC, where lots of networked individual fibers became obviously very small and are hard to be measured precisely at the individual non-fused fiber sections; b) S1-pent green fibers start to fuse lightly until the temperature reached to 350 ºC under nitrogen.