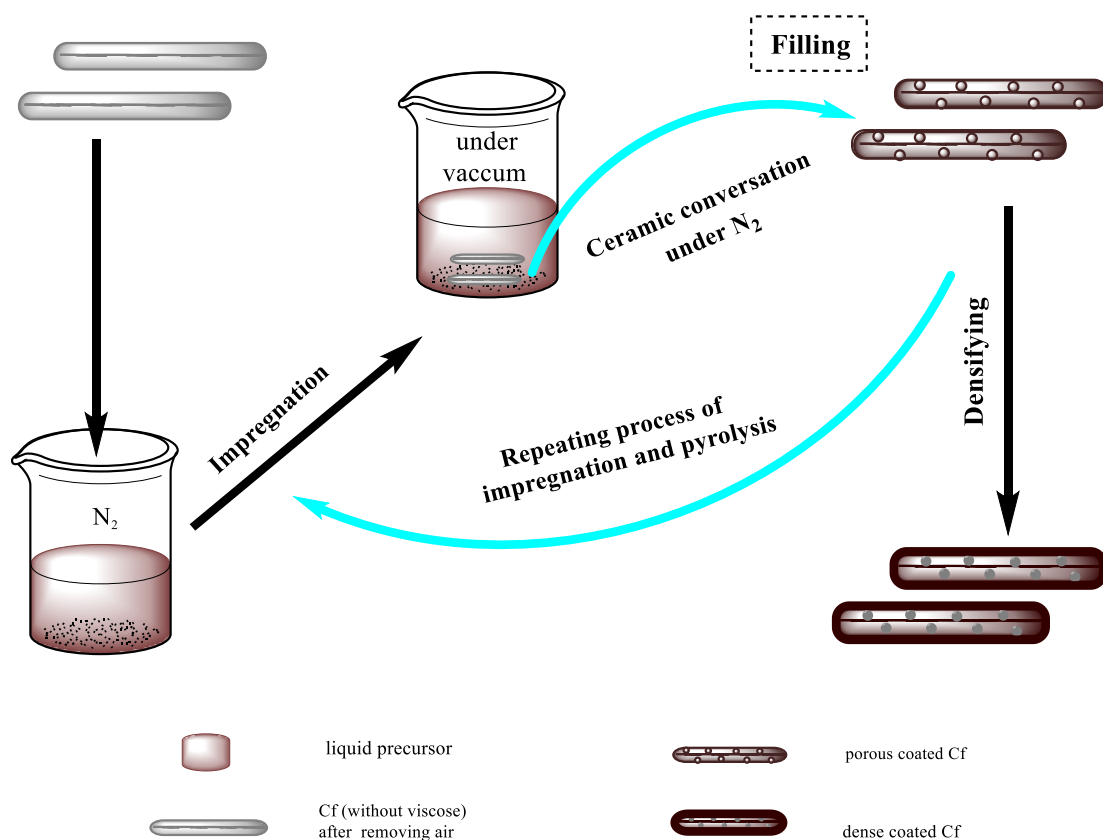


1: Highlights

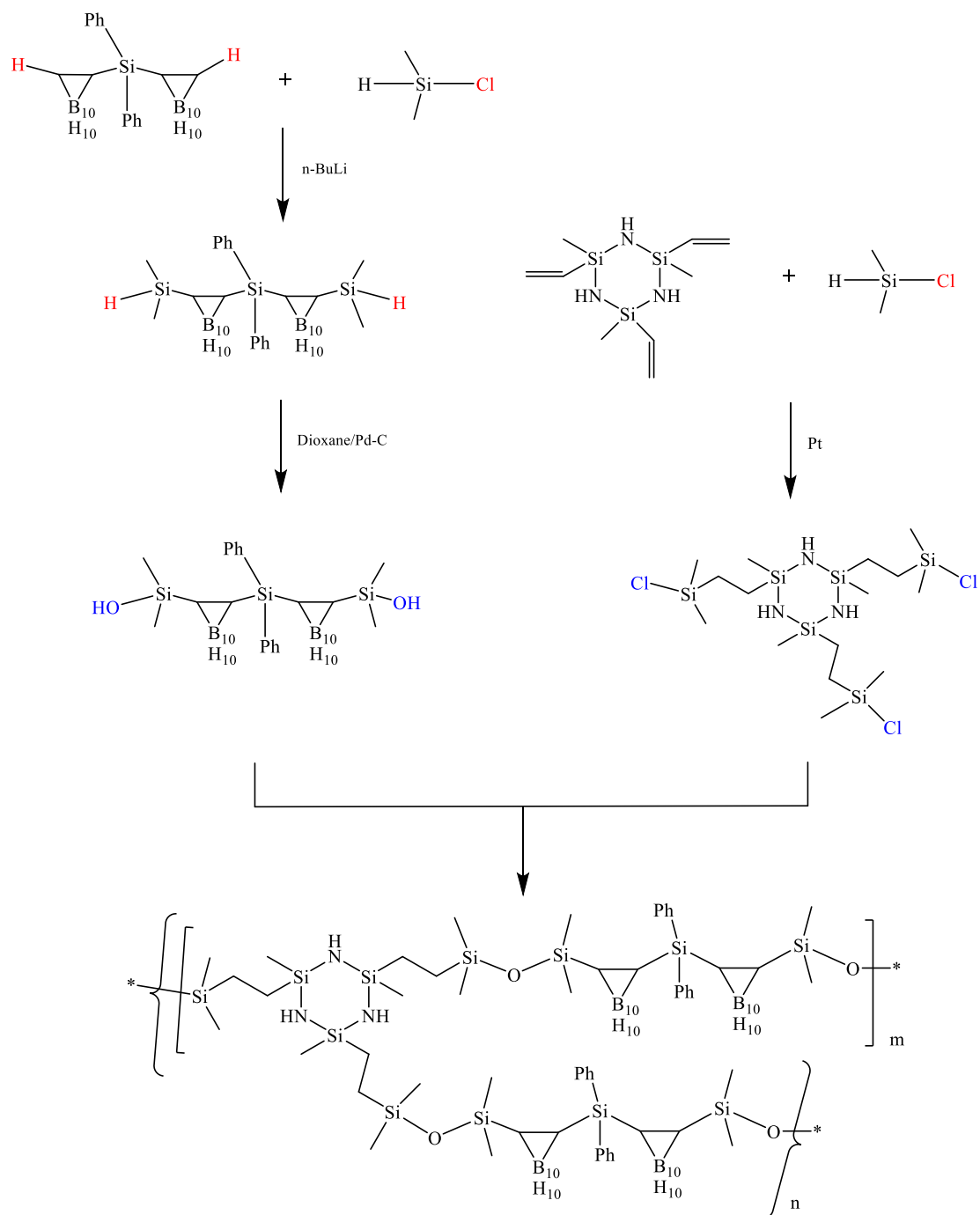
- 1) A new claw-shaped type of carborane monomer is designed.
- 2) The SiBCN ceramic precursor is obtained by single-source precursor polymerization.
- 3) The carbon fiber coating is prepared by precursor infiltration pyrolysis (PIP) method.
- 4) The thickness of carbon fiber coating can be controlled by the concentration of the precursor solution and the number of PIP cycles.
- 5) The coated carbon fiber exhibits superior overall performance compared to the uncoated fiber.

2: Graphical Abstract



The schematically illustration of the preparation of coated Cf via PIP

3: Figures



Scheme 1. Synthetic route of **SiBCN** precursor

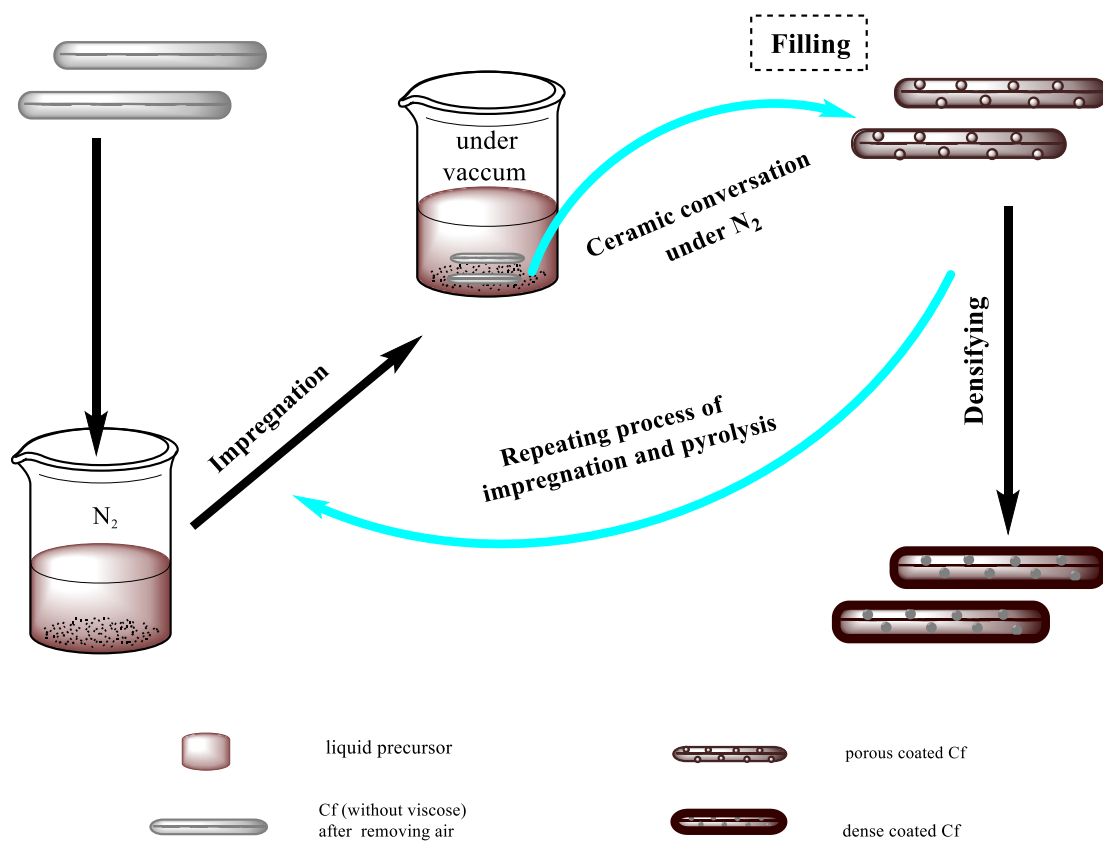


Fig. 1. The schematically illustration of the preparation of coated Cf via PIP.

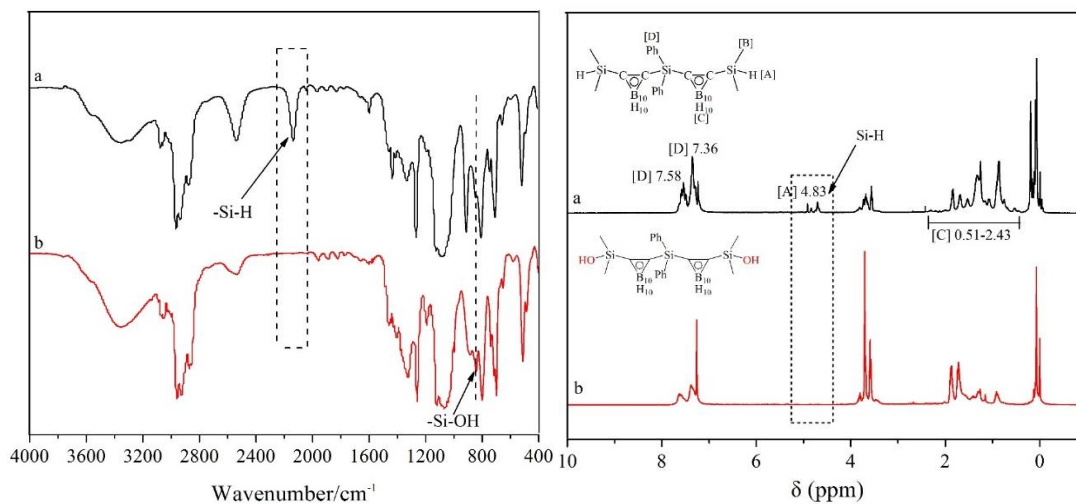


Fig. 2. FTIR spectra (left) and ¹H-NMR spectra (right): curve (a): H-Si-Carborane curve (b): HO-Si-Carborane.

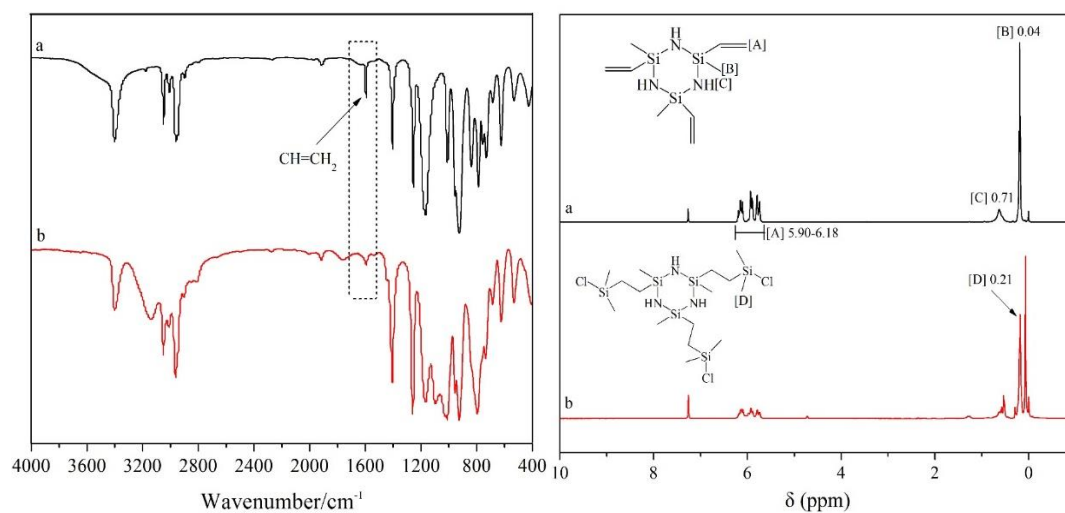


Fig. 3. FTIR spectra (left) and ^1H -NMR spectra (right): curve (a): C=C-Silazane; curve (b): Cl-Si-Silazane.

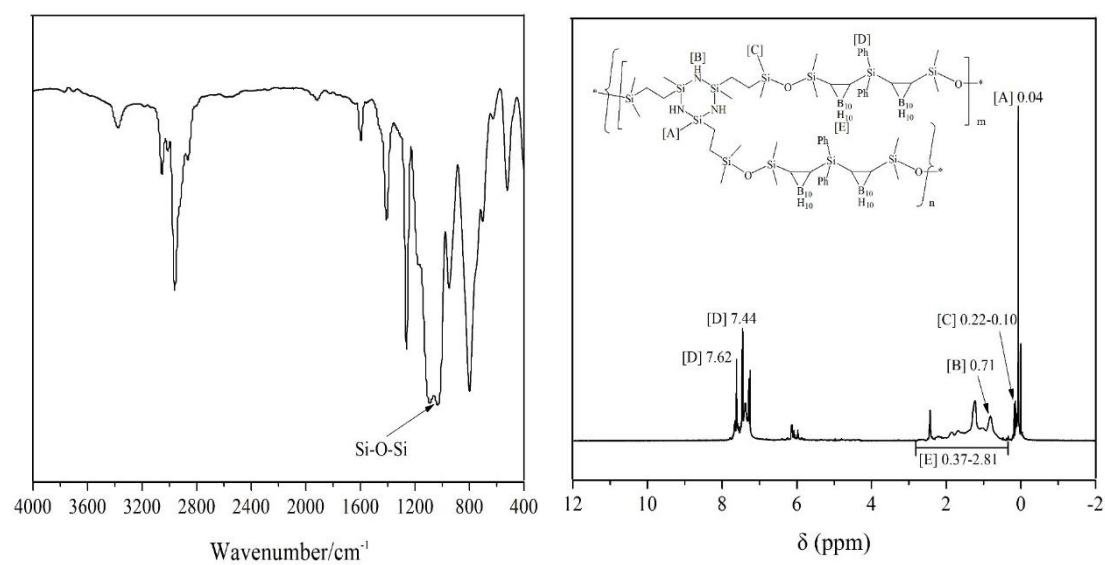


Fig. 4. FTIR spectra (left) and ^1H -NMR spectra (right): **SiBCN precursor**

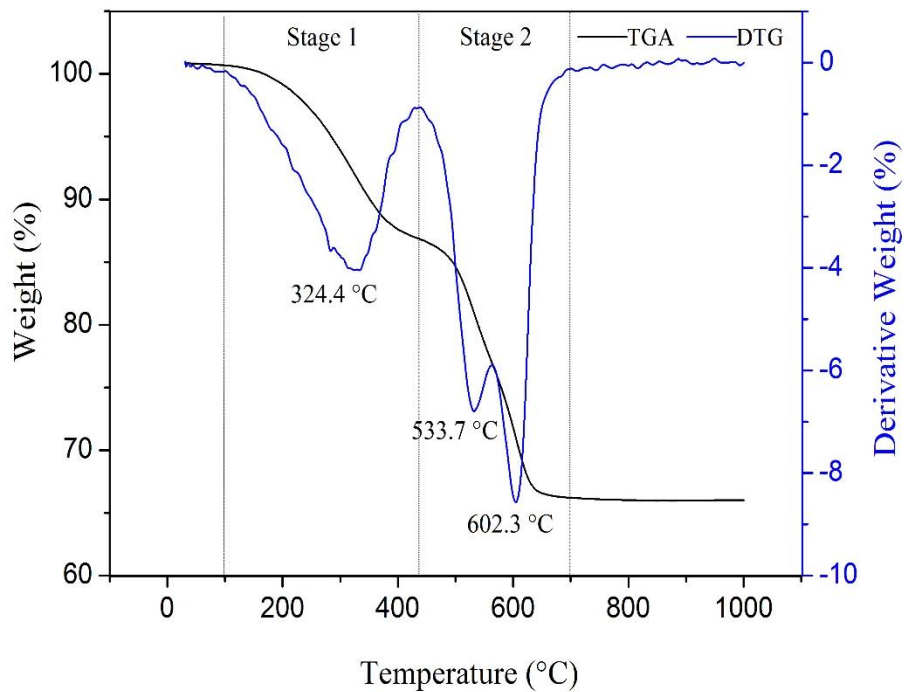


Fig. 5. The TGA/DTG curves of **SiBCN** heating from room temperature to 1000 °C in nitrogen.

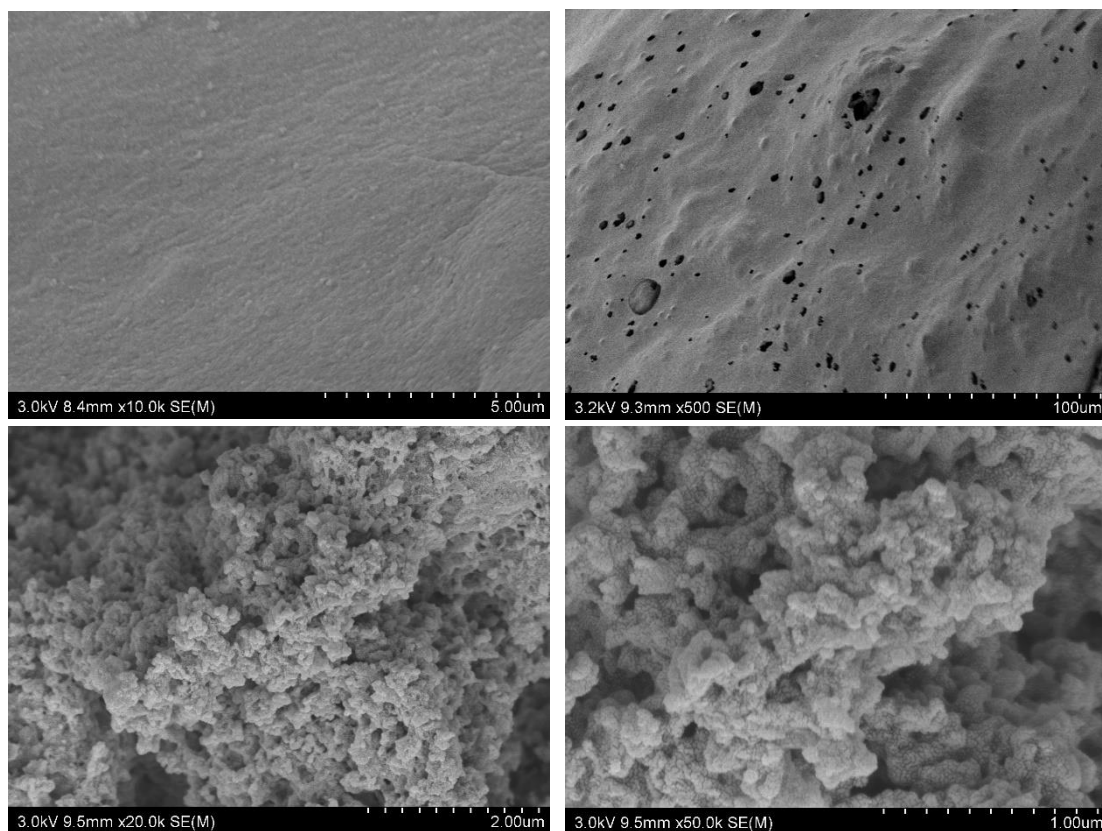


Fig. 6. Ceramic structure morphology of **SiBCN** (SEM images).

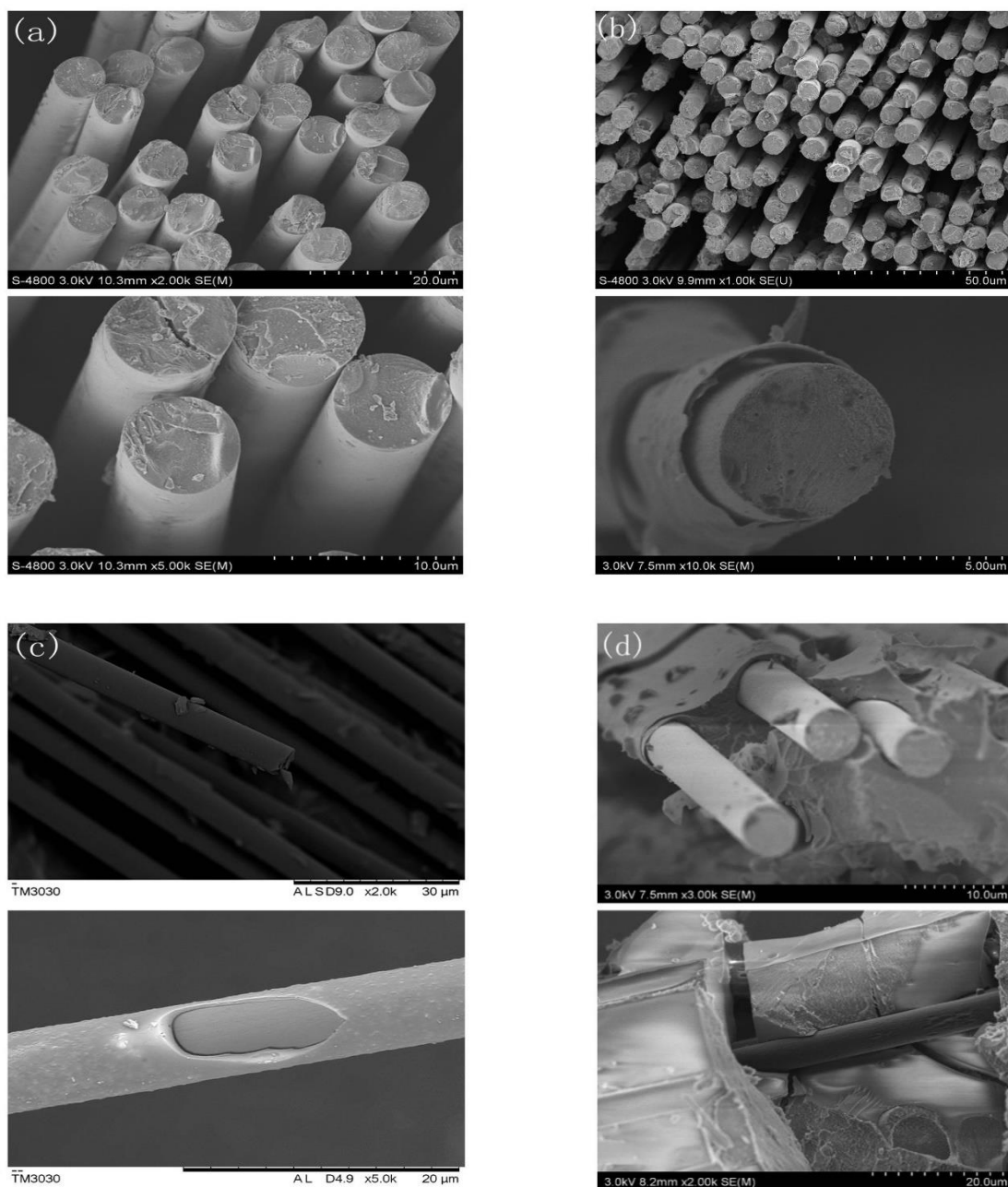


Fig. 7. SEM images of cross-section of carbon fiber (a), (b) and fiber surface (c), (d). (a) uncoated fiber, (b), (c), (d) coated fiber.

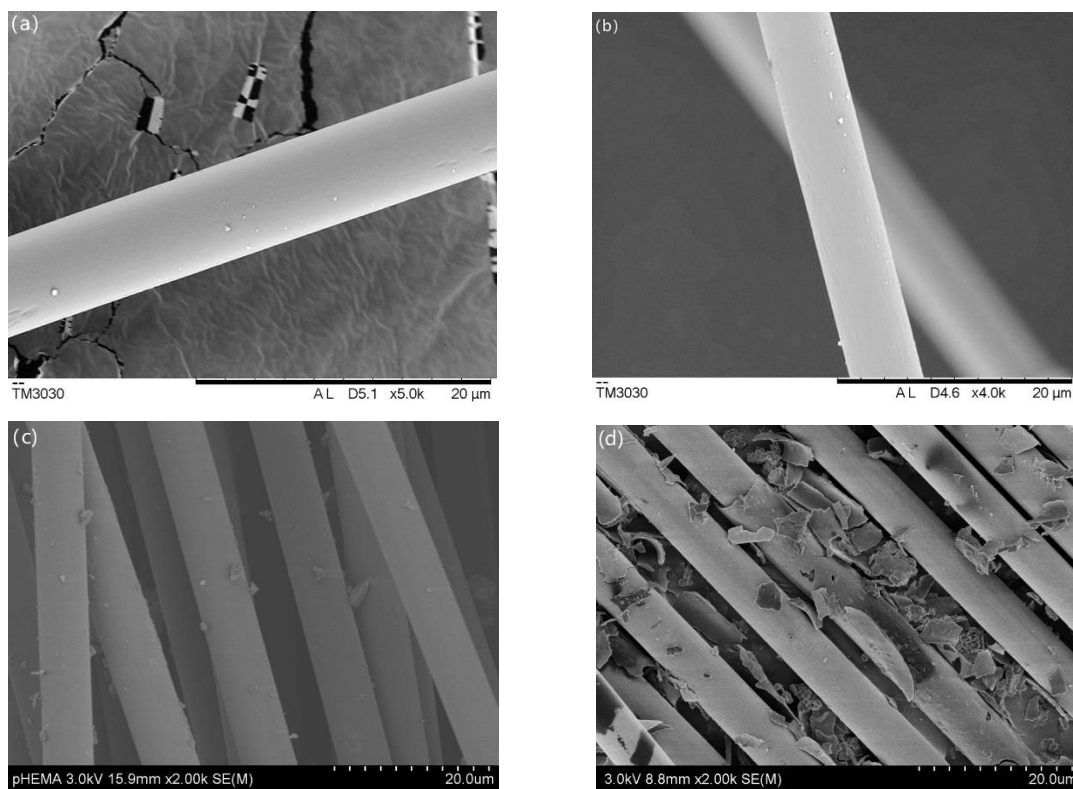


Fig. 8. SEM image of carbon fiber after different times of PIP cycles. (a) once, (b) twice, (c) three times, (d) four times.

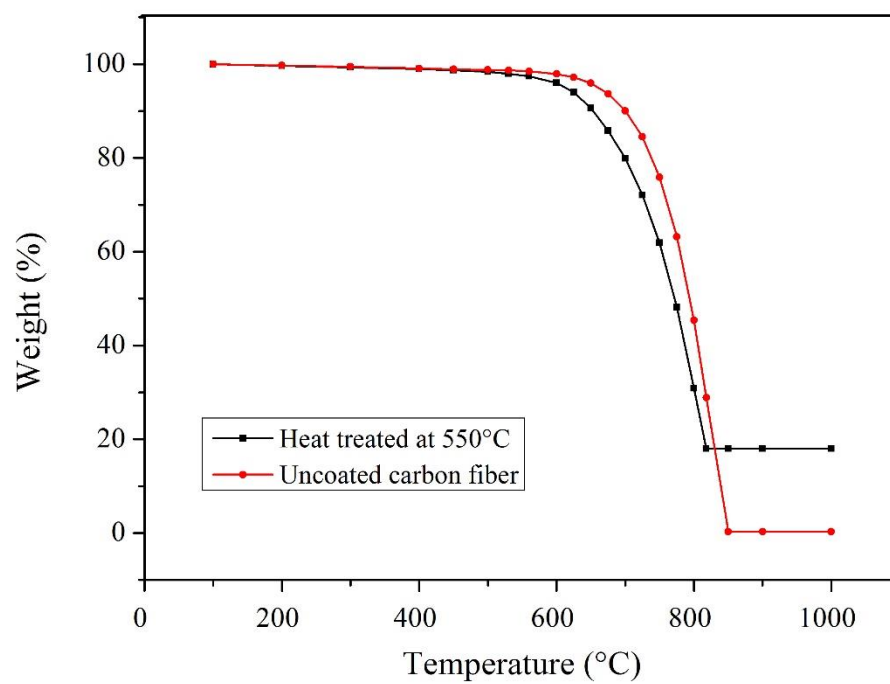


Fig. 9. TGA curves of coated and uncoated carbon fiber heating from room temperature to 1000 °C in an air atmosphere.

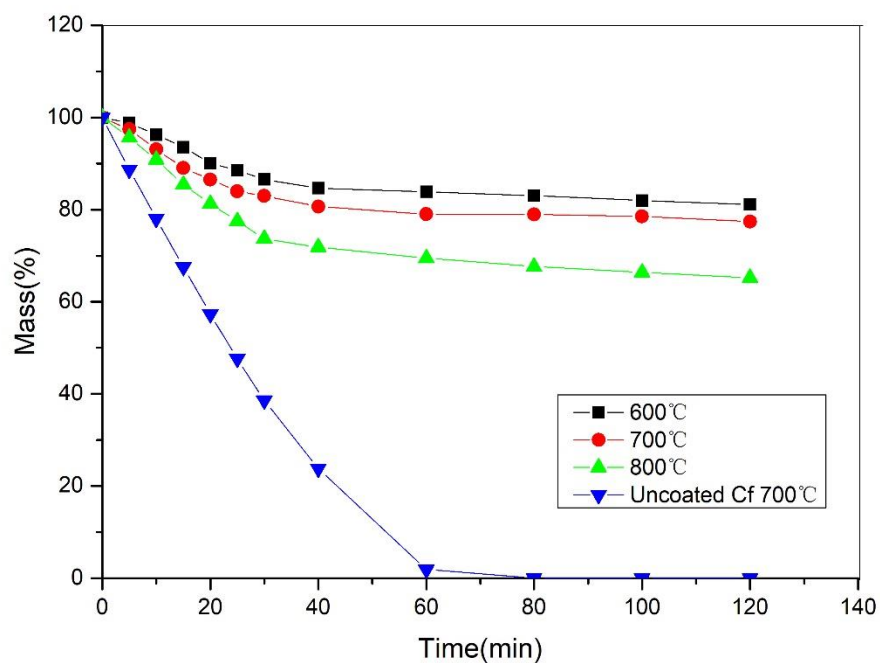
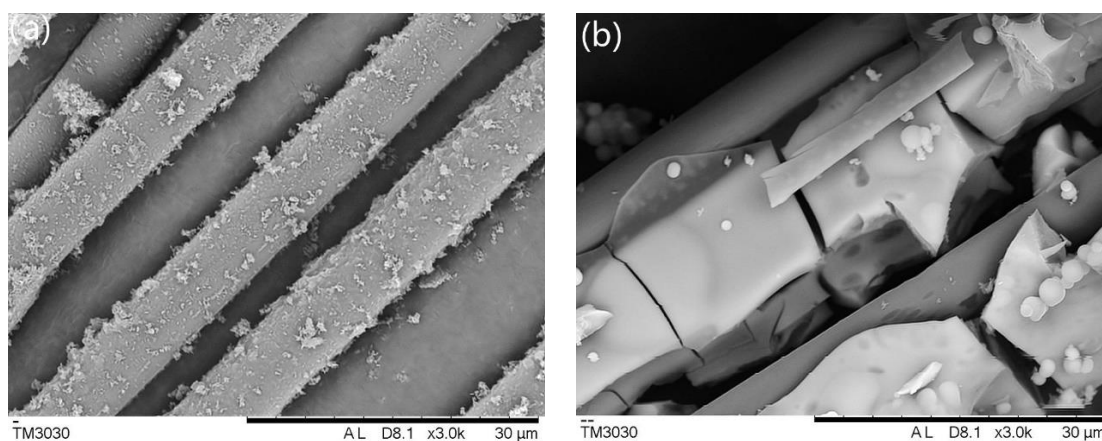


Fig. 10. Thermogravimetric curve of carbon fiber oxidizing at different temperatures (3 PIP cycles and the treatment solution was 0.36g/ml).



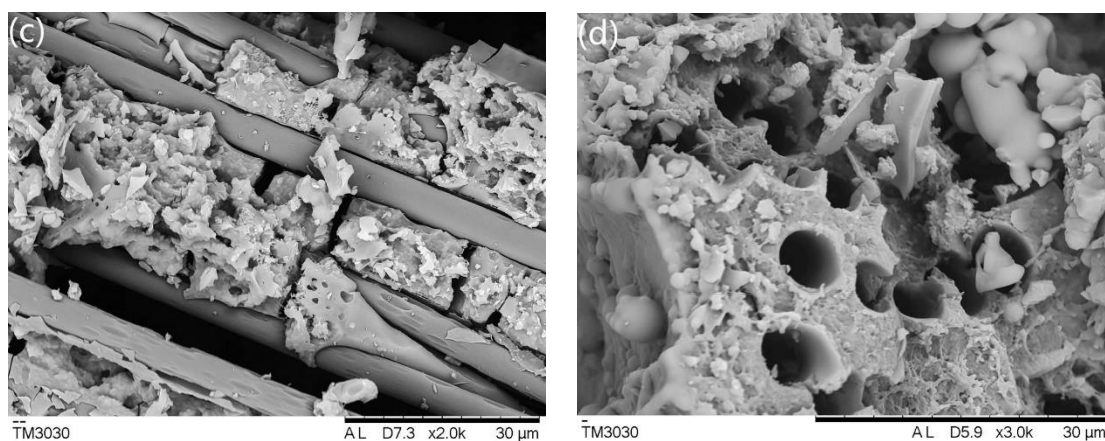


Fig. 11. SEM image of coated carbon after oxidation for 120 min at different temperatures. (a) 600 °C, (b) 700 °C, (c) 800 °C (d) 900°C.

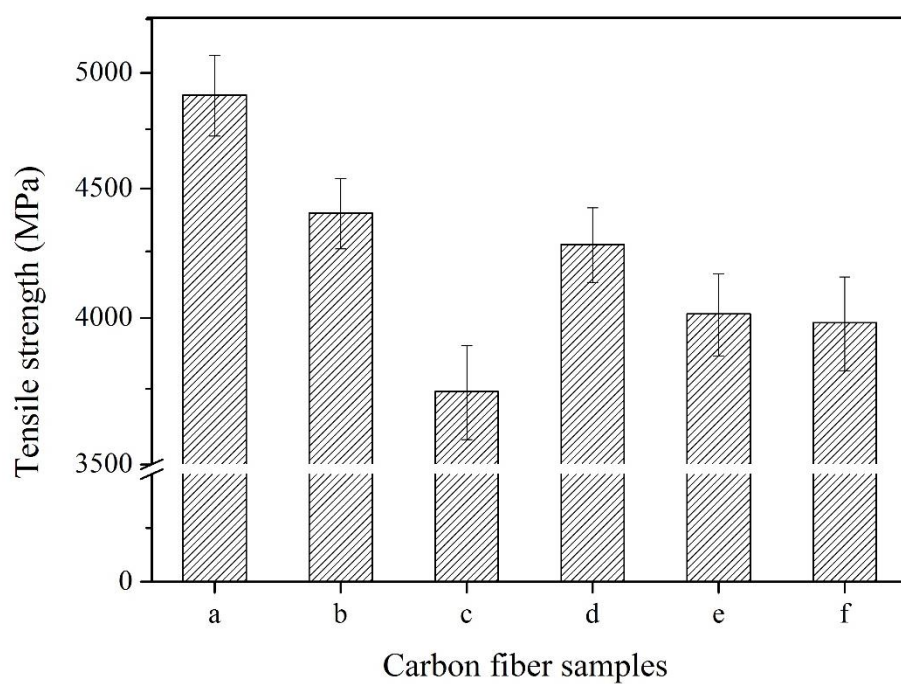
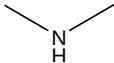
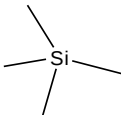
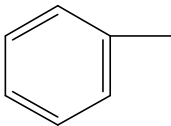
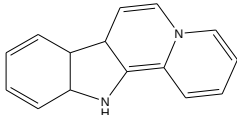
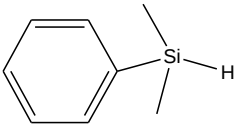
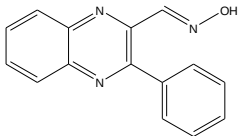
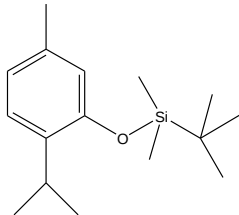
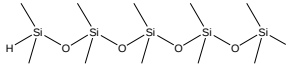
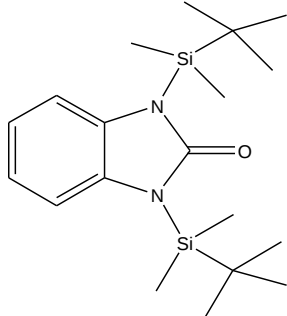
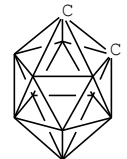
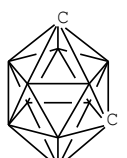
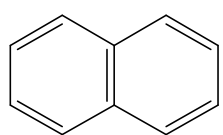
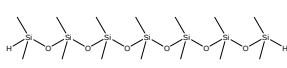
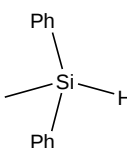


Fig. 12. Tensile strength of carbon after treatment under different conditions. (a) original fiber, (b) degummed fiber, (c) degummed fiber soaked in HNO₃ solution, (d) to (f) corresponding to the concentration of 0.36 g/ml of treatment liquid, treated 1 to 3 times of coated fiber.

4: Tables

Table 1. Pyrolysis products of Carborane-silazane prepolymer at 700 °C.

Label	Molecular formula	Molecular structure	Mw (g/mol)	Peak area (%)
1	C ₂ H ₇ N		45	0.22
2	CH ₅ N		31	1.74
3	C ₄ H ₁₂ Si		88	0.91
4	C ₇ H ₁₂		92	0.96
5	C ₅ H ₁₂ N ₂		220	0.68
6	C ₈ H ₁₂ Si		136	0.28
7	C ₁₅ H ₁₁ N ₃ O		249	0.84

8	$C_{16}H_{28}OSi$		280	0.23
9	$C_{10}H_{32}O_4Si_5$		356	0.18
10	$C_{19}H_{34}N_2OSi_2$		362	0.63
11	$C_2B_{10}H_{12}$		146	2.52
12	$C_2B_{10}H_{12}$		146	0.63
13	$C_{10}H_8$		128	0.21
14	$C_{14}H_{44}O_6Si_7$		504	2.53
15	$C_{13}H_{14}Si$		198	0.23

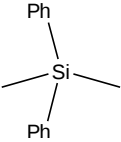
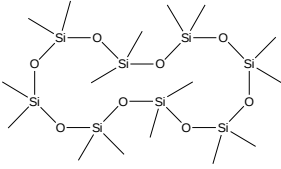
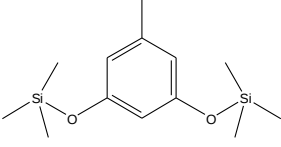
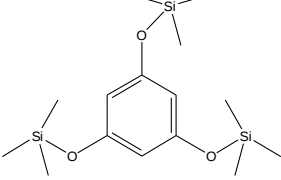
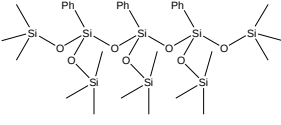
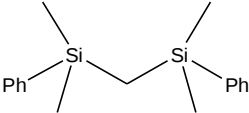
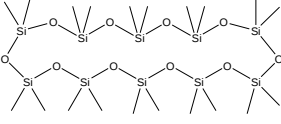
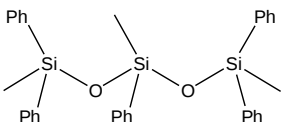
16	$C_{14}H_{16}Si$		212	0.24
17	$C_{16}H_{48}O_8Si_8$		592	0.30
18	$C_{13}H_{24}O_2Si_2$		268	5.02
19	$C_{15}H_{30}O_3Si_3$		342	1.10
20	$C_{33}H_{60}O_7Si_8$		792	0.55
21	$C_{16}H_{22}Si_2$		270	2.98
22	$C_{20}H_{60}O_{10}Si_{10}$		740	0.23
23	$C_{33}H_{34}O_2Si_3$		546	0.33

Table 2. Mass of coated fiber under different concentrations and oxidizing at 600 °C for 180 min in an aerobic environment.

Weight residue (%)

Concen	Immersion						
-tration	pyrolysis	0 min	20 min	40 min	60 min	120 min	180 min
/ g/ml	cycles						
0.12	1	100.00	97.2	94.4	80.6	66.6	55.6
	2	100.00	93.3	89.4	83.3	68.8	56.7
	3	100.00	114.9	91.5	78.7	63.8	59.6
0.24	1	100.00	96.4	82.1	69.6	62.5	54.9
	2	100.00	95.7	88.2	80.7	65.4	59.3
	3	100.00	98.0	91.5	87.7	78.2	67.7
0.36	1	100.00	98.3	82.5	76.7	70.0	56.2
	2	100.00	104.6	88.3	81.8	74.7	69.5
	3	100.00	104.9	96.5	90.3	83.7	75.7
	4	100.00	108.3	100.0	89.8	76.7	67.9
0.48	1	100.00	108.6	92.6	83.7	73.0	55.4
	2	100.00	107.6	98.3	87.8	76.7	68.5
	3	100.00	110.6	97.1	94.2	81.7	70.3