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Catalyst-free large-scale synthesis of composite $SiC@SiO_2$ /carbon nanofiber mats by blow-spinning

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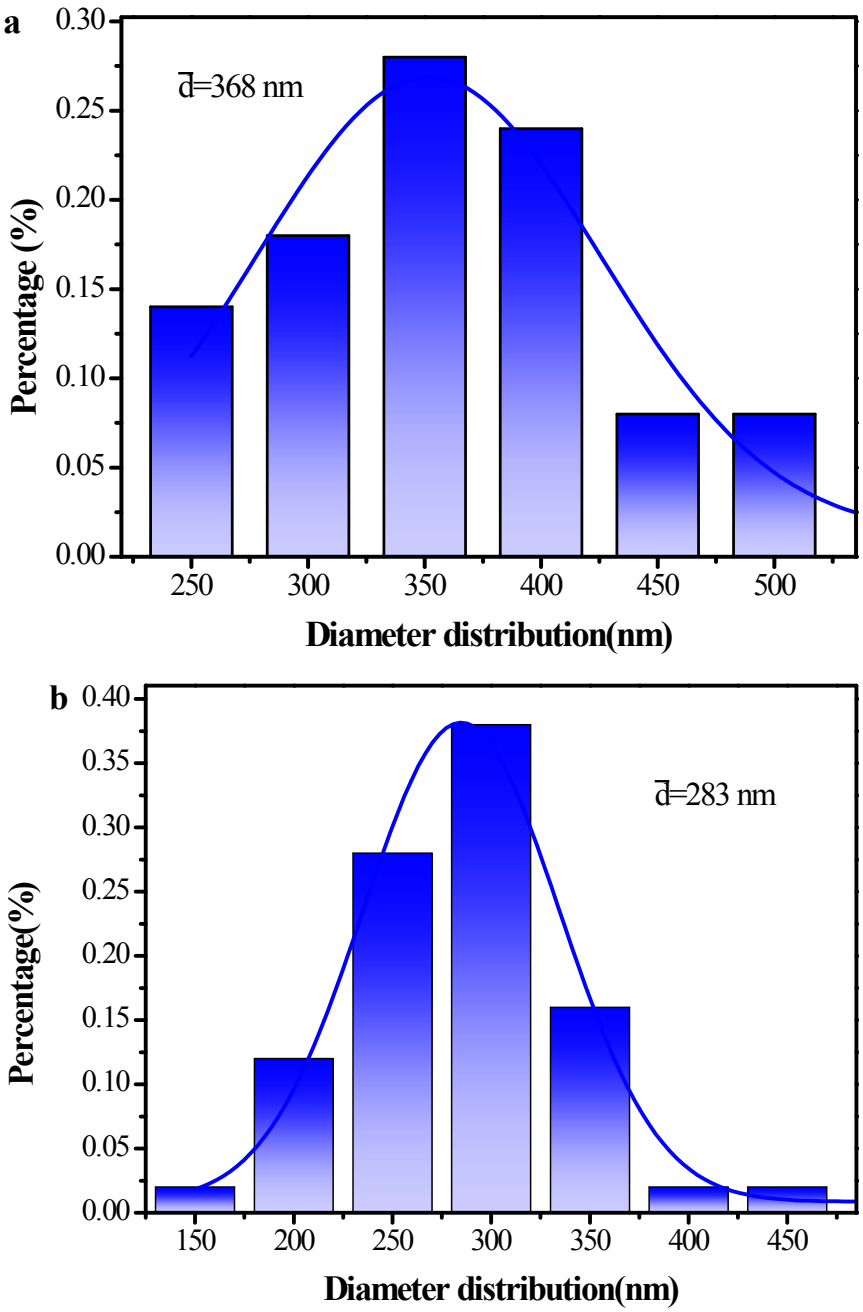

Figure S1. Diameter distribution curves of as-spun nanofibers (a) and pre-oxidized nanofibers (b). Each data point is averaged over 50 measurements (measured by FiberMetric, Fiber statistical analysis measurement system).

The as spun nanofibers have a relatively broad size distribution with an average diameter of 368 nm. After pre-oxidation, the average diameter shrinks to 283 nm due to a series of reactions such as, cyclization, cross-linking, dehydrogenation and oxidation in the heated PAN molecular chain, [1-5].

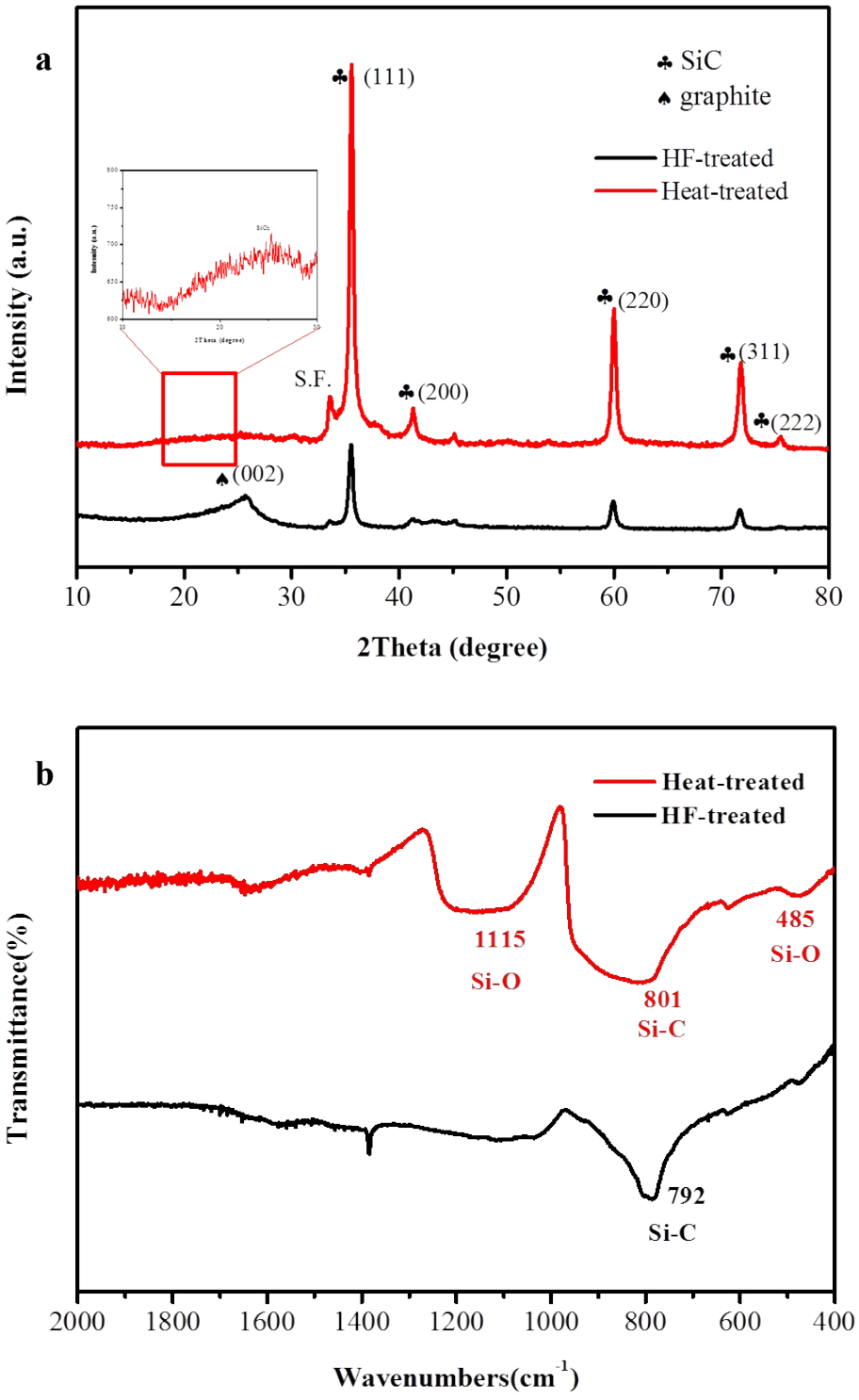

Figure S2. (a) XRD patterns and (b) FTIR spectra of HF-treated (SiC-CNFMs-5) and Heat-treated (SiC/SiO_2), respectively.

As shown in **Figure S2a**, five strong peaks, attributed to the (111), (200), (220), (311) and (222) planes of cubic β-SiC (unit cell parameter = 0.43589) (JCPDS Card No. 29-

1129) are identified [6]. Both HF-treatment and heat-treatment have no effect on the crystal structure of SiC nanofibers. Further, in the XRD pattern of SiC-CNFMs-5, the diffraction peak of SiO_2 is not observed, indicating that the HF acid successfully dissolved the SiO_2. Similarly, the XRD spectrum of the SiC/SiO_2 obtained after the heat treatment shows no carbon diffraction peak. As shown in **Figure S2b**, it is confirmed that only the stretching vibration peak of Si-C is present in the FTIR spectrum of SiC-CNFMs-5, i.e., the Si-O signal is absent as a result of the HF treatment. The 485, 1115 and 801 cm^{-1} peaks in the FTIR spectrum of Si/SiO_2 are attributed to Si-O and Si-C stretching [7,8], respectively.

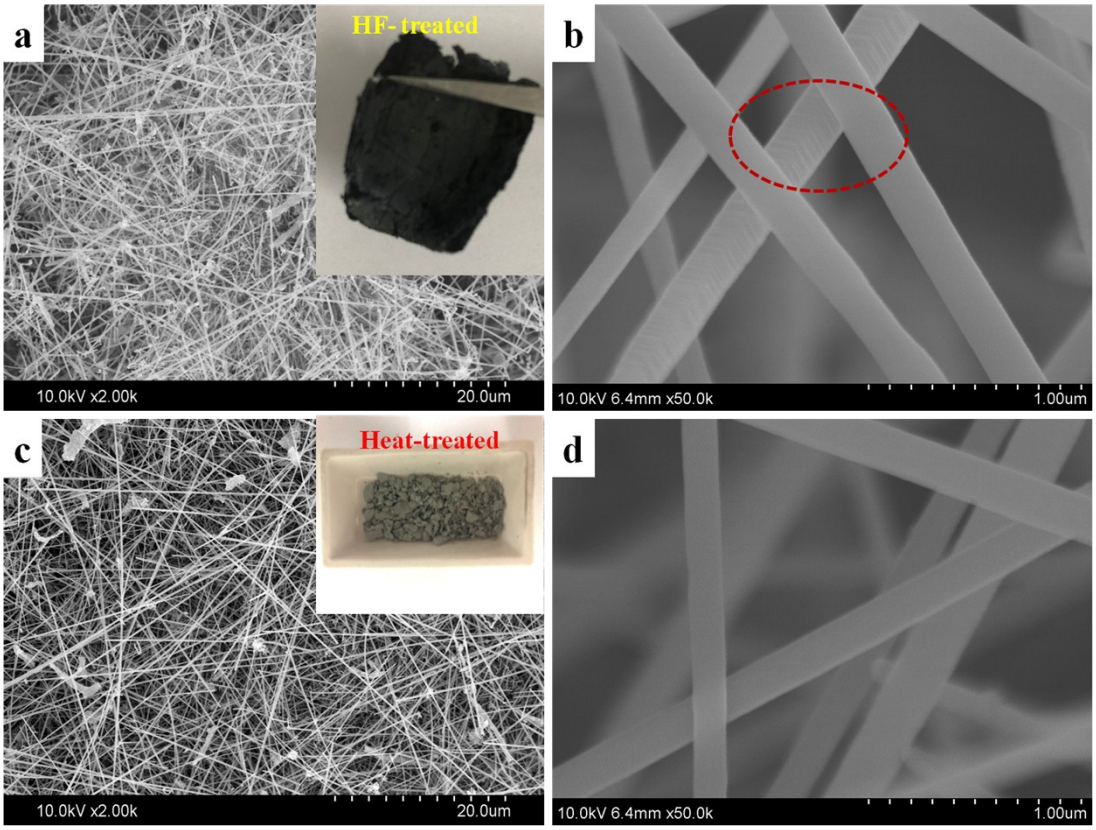

Figure S3. SEM images of SiC-CNFMs-5.a and b are low magnification and high magnification SEM of SiC-CNFMs-5, respectively; c. and d. are low magnification and high magnification SEM of SiC/SiO_2, respectively. The inset is a macroscopic photo of SiC-CNFMs-5 and SiC/SiO_2, respectively.)

As shown in **Figure S3**, SiC-CNFMs-5 maintains a complete fiber mat after HF treatment, the crystal nanofibers roughen (red mark in **Figure S3b**) and the heat treatment causes SiC@CNFMs-5 to be converted into powdered SiC/SiO_2 inset in **Figure S3c**), but the fiber structure is unaffected (**Fig S3d**).

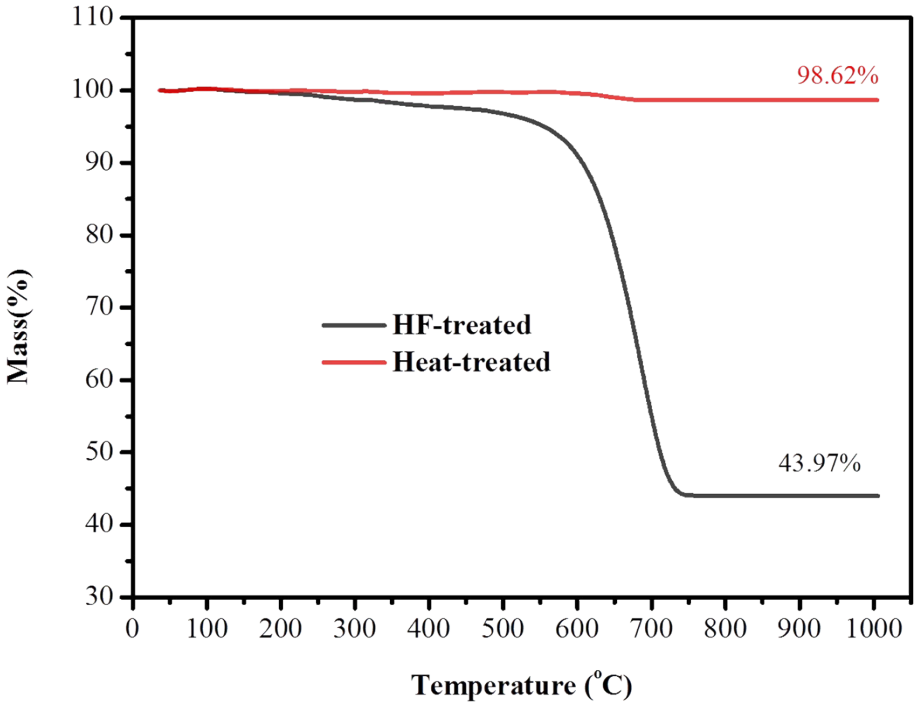

Figure S4. TGA curve measured in air of HF-treated (SiC-CNFMs-5) and Heat-treated (SiC/SiO_2)

As shown in **Figure S4**, for the thermogravimetric graphs of SiC-CNFMs-5 and SiC/SiO_2, the SiC content in SiC@CNFMs-5 is determined to 43.97%. By comparison with the thermogravimetric curve of SiC@CNFMs-5 shows a residual mass of 44.10 wt% and since the difference between the two samples is the removal of SiO_2 by the HF etching,, mass percentage of the SiO_2 shell on the SiC nanofibers is about 0.13%. It can be seen from the thermogravimetric graphs of the heat treated SiC/SiO_2 that it has excellent oxidation resistance from room temperature to 1000°C.

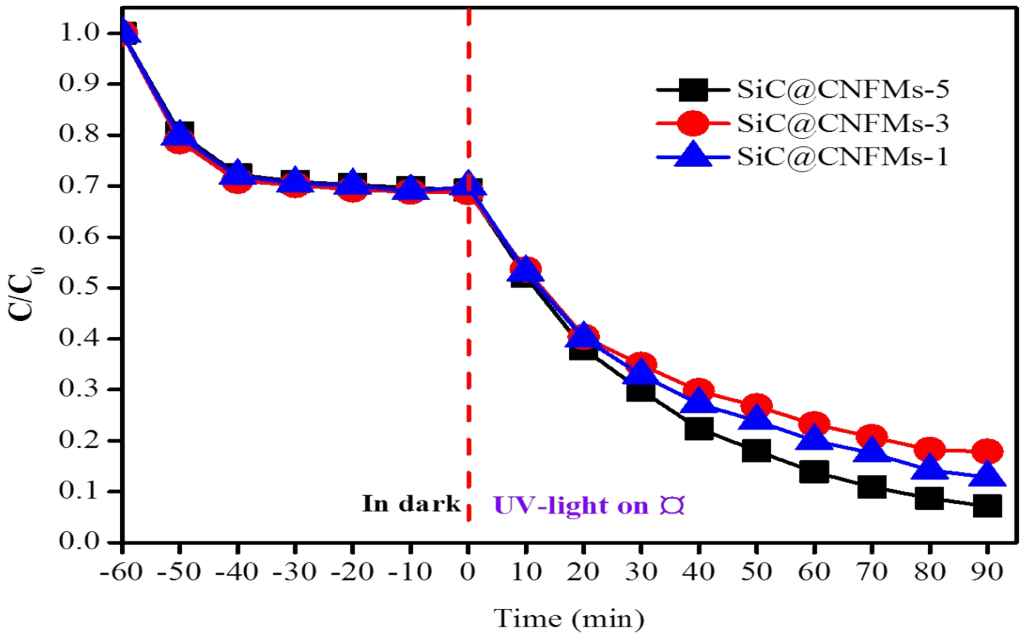

Figure S5. Photocatalytic degradation of MO on the SiC@CNFMs-1, SiC@CNFMs-3, and SiC@CNFMs-5.

As shown in **Figure S5** there is no significant difference in the adsorption in darkness for the three samples. As expected, SiC@CNFMs-5 performs better for the photocatalytic degradation efficiency of MO that samples exerted to shorter durations at 1400 °C. This difference in catalytic degradation is explained by increased amount of effective photocatalyst (SiC/SiO_2 crystal nanofiber) with heat treatment duration (**Table S1)**.

Table S1 The SiC/SiO_2 content in SiC@CNFMs exerted to different holding times.

Holding Time /h	$M_{SiC@CNFMs}$ /mg	$M_{SiC/SiO2}$ /mg
SiC@CNFMs-1		9.51
SiC@CNFMs-3	30	11.46
SiC@CNFMs-5		13.22

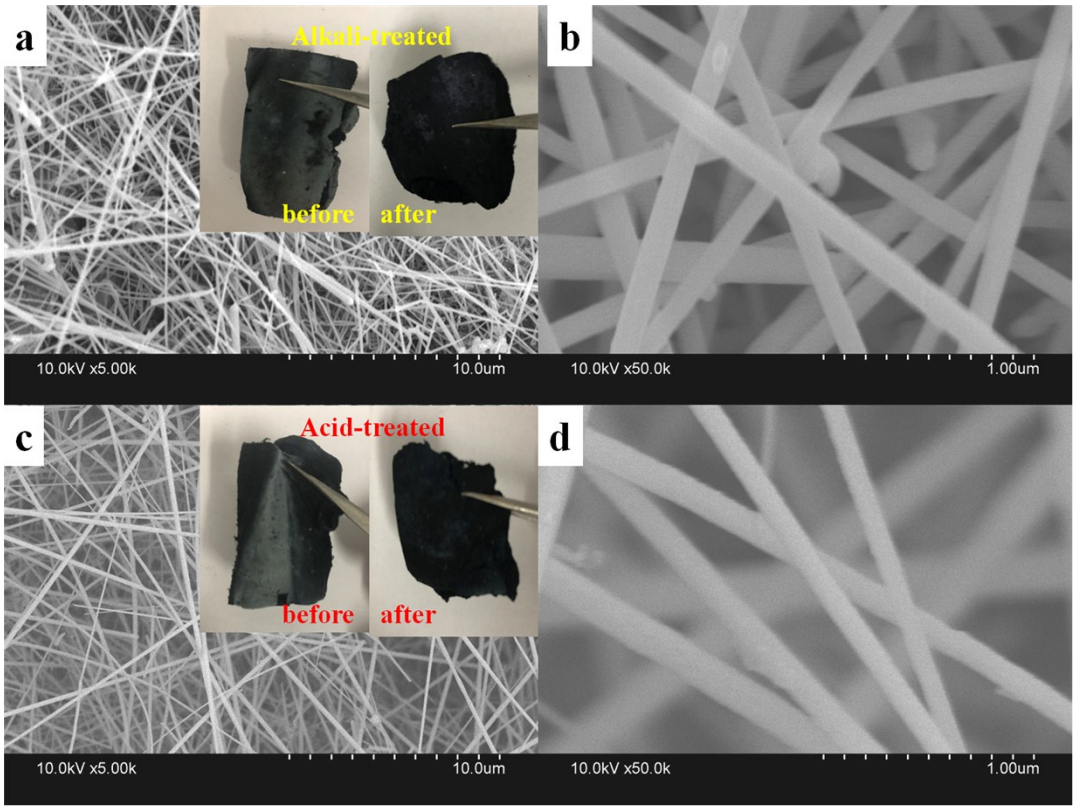

Figure S6. SEM images of SiC@CNFMs after being immersed into (a. and b.) 2M NaOH and (c. and d.) 2M H_2SO_4 for 48 h; (The inset is the Digital photo of SiC@CNFMs before and after treated by NaOH and H_2SO_4 , respectively.)

After 48 h immersion in 2M H_2SO_4 and 2M NaOH followed by washing with water and drying, the SiC@CNFMs retain their macroscopic mat like structure (**Figure S6**). thus it is demonstrated that the SiC@CNFMs have excellent chemical stability, which is attributed to the inert hybrid carbon nanofibers and nanocrystalline fibers.

References

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