

Supporting Information

Flexible graphene fibers prepared by chemical reduction-induced self-assembly

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Materials:

Graphite flake (~500 μm) was obtained from Sigma-Aldrich. Vitamin C (VC), Concentrated H_2SO_4 (98 %), KMnO_4 , P_2O_5 , H_2O_2 (30 %) solution and $\text{K}_2\text{S}_2\text{O}_8$ were purchased from Sinopharm Chemical Reagent Co., Ltd. and used as received. Milli-Q water is used for all experiments unless otherwise stated.

Preparation of GO and graphene fibers (GFs)

GO sheets were prepared by the chemical oxidation of graphite flakes according to the modified Hummer's method reported previously [1]. We prepared GO sheets from natural graphite flakes with average lateral size of 500 μm . The process included three steps: expanded graphite (EG), pre-oxidized graphite, and GO sheets. (Note: without ultrasonication).

In a typical fabrication of GFs, a propylene (PP) pipeline with the inner diameter of 8 mm was used as the reactor. And a mixture of 10ml GO suspension (1-4 mg/mL) and VC ($\text{GO}_{\text{wt}}:\text{VC}_{\text{wt}}=1:5$) was injected into an 18cm-long one end sealed pipeline and reacted at 80 $^\circ\text{C}$ for 1 h. Finally, a 1D GF matching the pipe geometry was produced after drying in air at 40 $^\circ\text{C}$ overnight and then drying in vacuum at 60 $^\circ\text{C}$ overnight for characterization.

Characterization:

X-ray photo-electron spectroscopy (XPS) spectra were recorded by using a SHIMADZU Kratos AXIS Ultra DLD XPS instrument equipped with a monochromated Al $\text{K}\alpha$ X-ray source. High resolution scans were acquired with 40 eV pass energy, wide-scan survey spectra were acquired with 160 eV pass energy.

X-ray diffraction (XRD) spectra were recorded on a RIGAKU D/Max 2200 X-Ray diffractometer with Cu- $\text{K}\alpha$ radiation ($\lambda = 1.54 \text{ \AA}$) at a generator voltage of 40 kV and a generator current of 50 mA. All experiments were carried out in the reflection mode at ambient temperature with 2θ in the range of 3 $^\circ$ to 80 $^\circ$. The scanning speed was 8 min^{-1} .

The morphologies of the fibers were characterized by a field-emission scanning

electron microscope (FE-SEM, JEOL, JSM6700F).

The observation of the GO surface features was carried out on a Digital Nanoscope IIIa Multimode SPM Atomic Force Microscope (AFM)

Tensile tests were performed by using INSTRON 5966 equipped with 500 N load cells. The strain ramp rate was controlled to be 1 mm/min for the tests.

The electrical conductivity of graphene fibers and was measured by a two-probe method using a digital multimeter (VC 890D, Shenzhen Victor Hi-tech Co. Ltd.)

The Brunauer–Emmett–Teller (BET) specific surface area and porous structure characteristics of the GFs were investigated by nitrogen isothermal adsorption using V-Sorb 2800TP Surface Area and Pore Distribution Analyzer instrument (Gold APP Instruments Corporation China, Beijing, China).

Laundering Durability Test: Laundering durability evaluation was carried out according to the AATCC (American Association of Textile Chemists and Colorists) Test Method 61–2006. The fabric with our GFs was laundered in a rotating closed canister containing 150 mL aqueous solution of an AATCC standard WOB detergent (0.15%, w/w) and 50 stainless steel balls in a thermostatically controlled water bath at 49 °C, 40 ± 2 rpm.

[1] H. Sun, Z. Xu, C. Gao, *Adv. Mater.*, 2013, 25, 2554-2560.

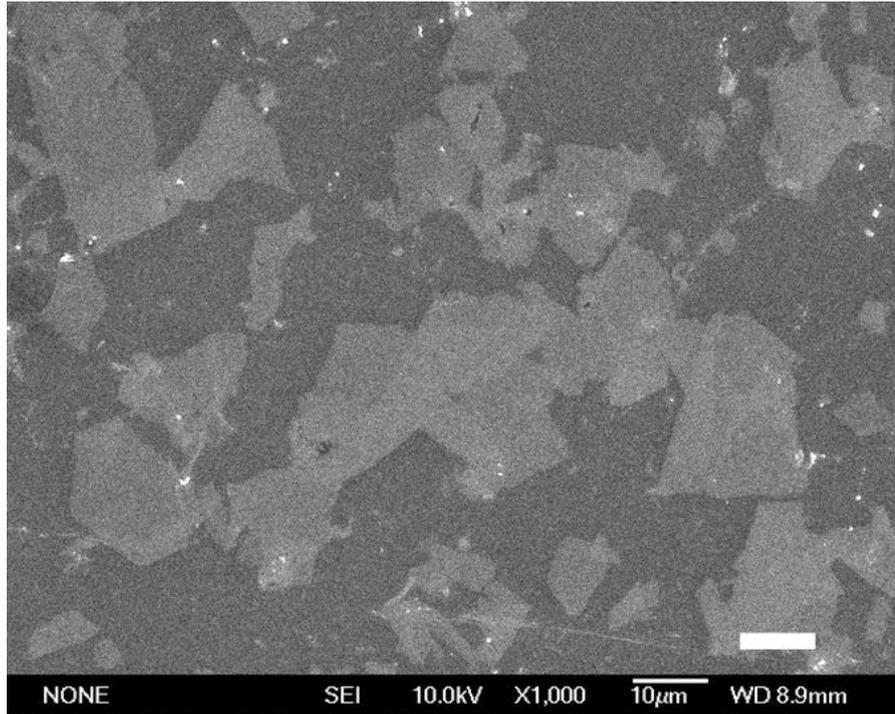


Figure S1. SEM images of the GO sheets obtained. The as-prepared GO is of an average lateral width of about 5-20 μm . Scale bar: 10 μm .



Figure S2. Photograph of the freeze-dried as-prepared wet-form GFs with different diameter released from the pipelines with the different inner diameter (from 2.5 to 8mm).

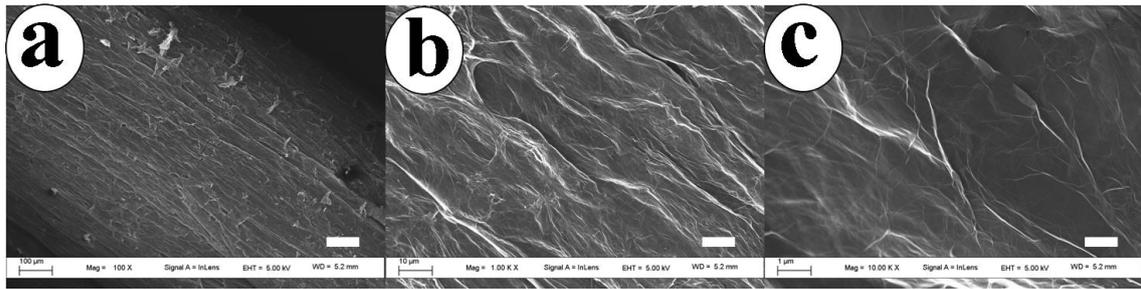


Figure S3. SEM images of the surface of the freeze-dried as-prepared wet-form GF with different magnifications. Scale bars: (a) 100 μm ; (b) 10 μm ; (c) 1 μm .

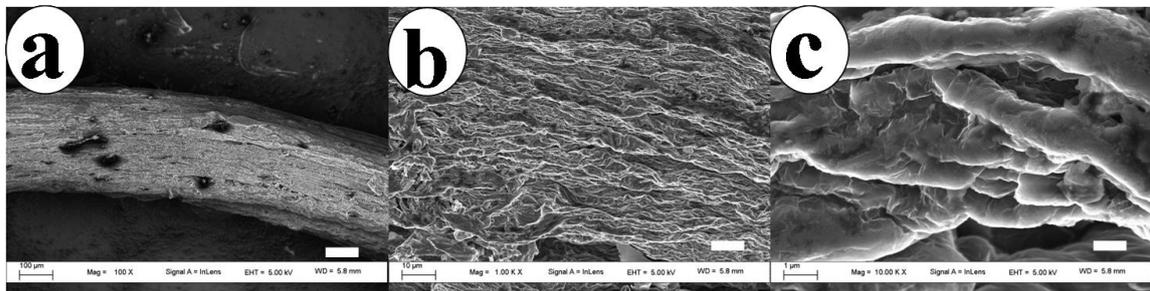


Figure S4. SEM images of the surface of the GF (with a GO concentration of 2 mg/mL in PP pipelines with an inner diameter of 8 mm.) with different magnifications. Scale bars: (a) 100 μm ; (b) 10 μm ; (c) 1 μm .

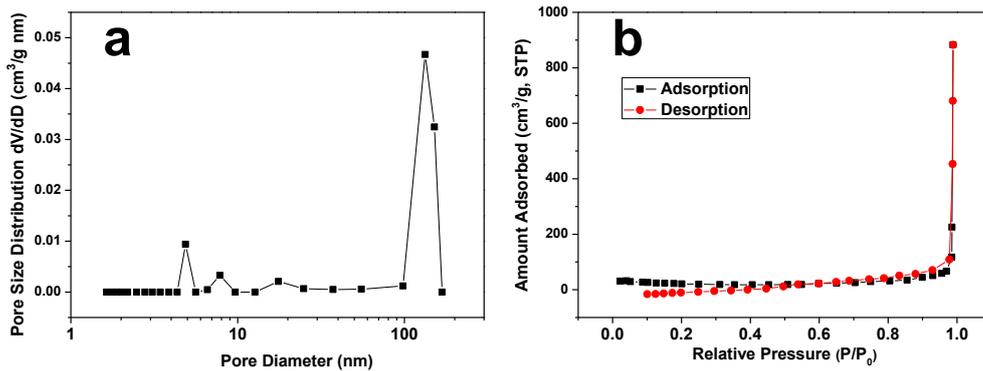


Figure S5. (a)BJH (Barret–Joyner–Halenda) adsorption pore size distribution of GFs; (b)Typical nitrogen sorption isotherms.

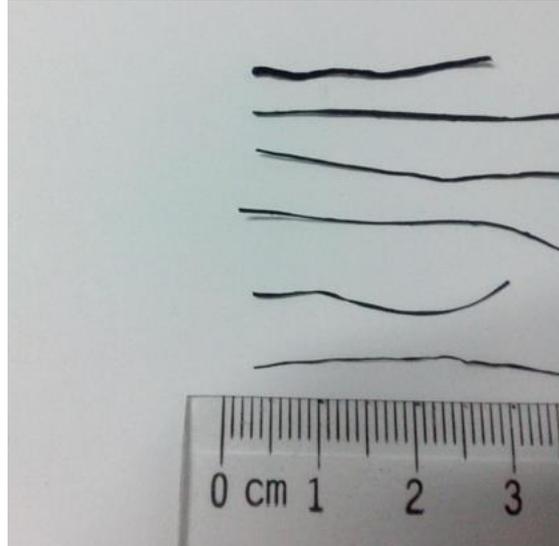


Figure S6. Photograph of the GFs prepared from the GO suspension of different concentration of 1, 1.5, 2, 2.5, 3 and 3.5 mg/mL with VC in PP pipelines with an inner diameter of 8 mm.

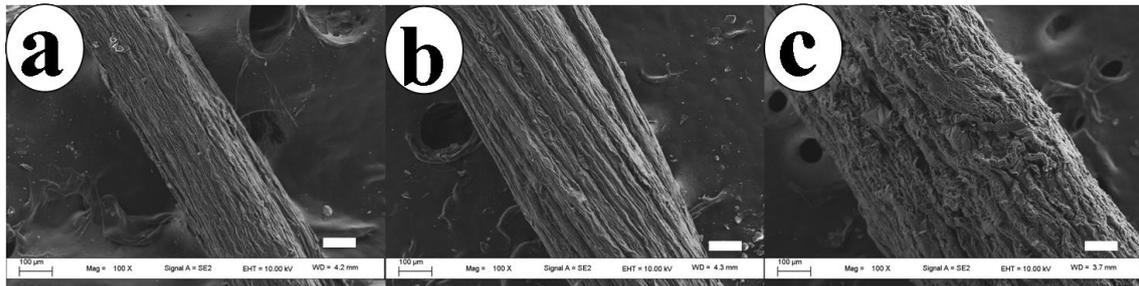


Figure S7. SEM images of the GFs prepared from the GO suspension of different concentration of 1.5, 2.5 and 3.5 mg/mL with VC in PP pipelines with an inner diameter of 8 mm. Scale bars: 100 μm .

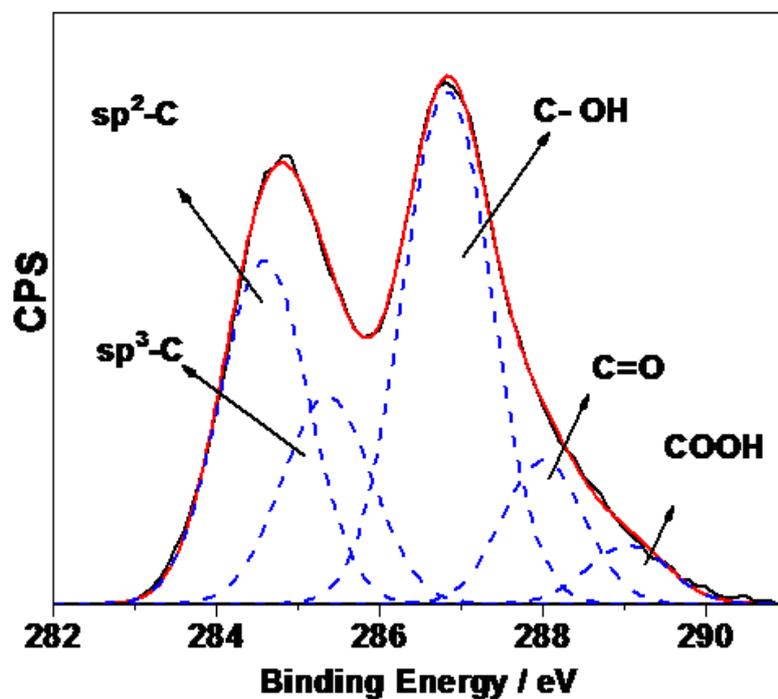


Figure S8. XPS C1s narrow scan spectrum of GO.

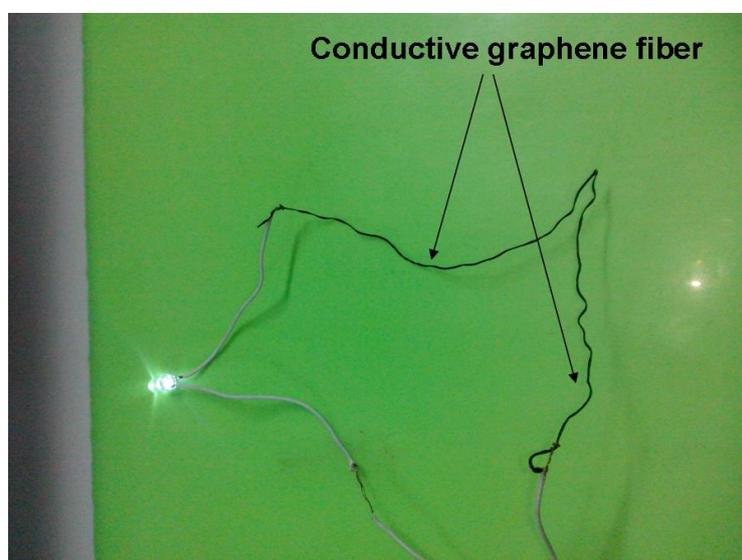


Figure S9. The obtained GFs have an electrical conductivity of $\sim 8\text{S/cm}$ at room temperature, and we connected the graphene fiber with a battery and a lamp to form a simple circuit.

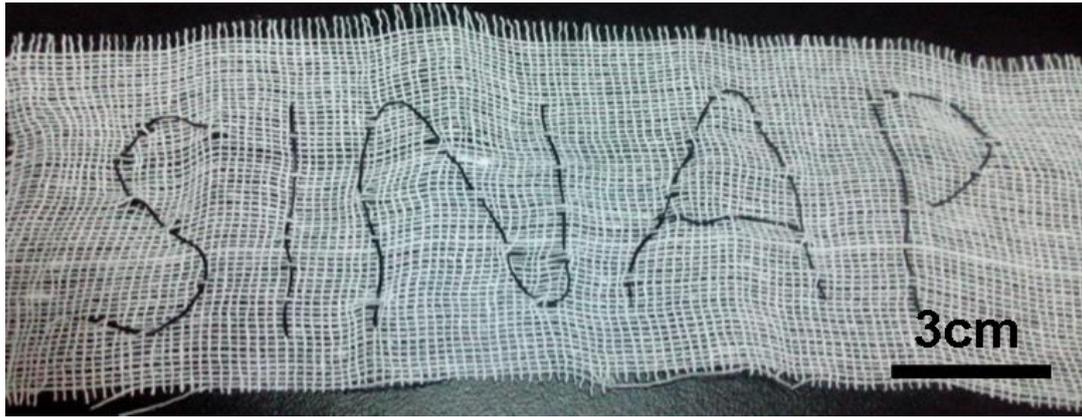


Figure S10. The knitted pattern of “SINAP” in a cotton textile using a needle with the GFs as the thread.

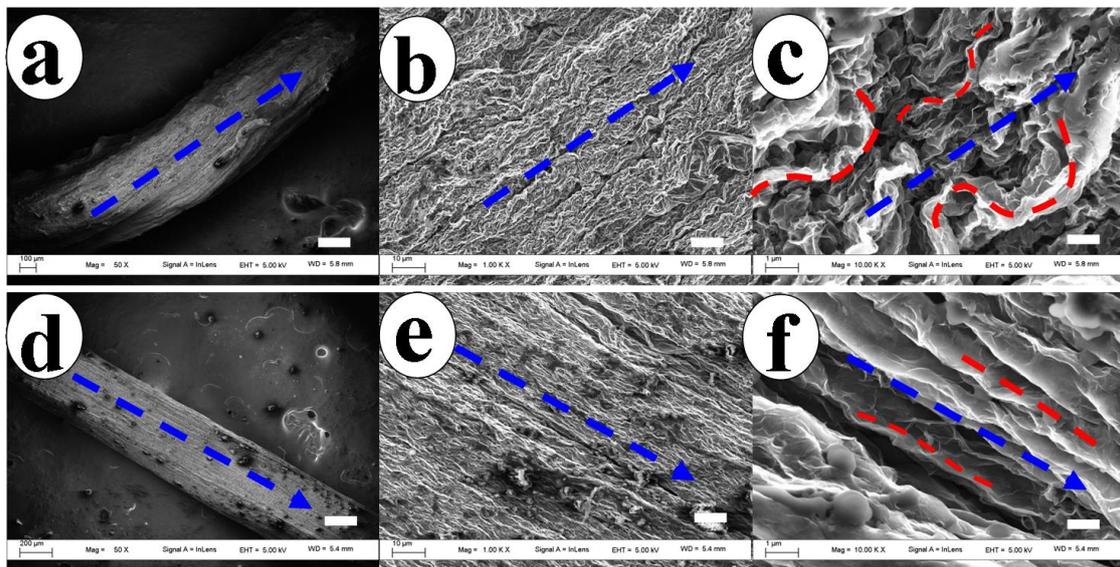


Figure S11. SEM images of the surface of the GFs before (a, b, c) and after (d, e, f) the tensile test at low and high magnification. Scale bars: (a,d)100 μm ; (b,e) 10 μm ; (c,f) 1 μm .



Figure S12. Images of a single GF which lift up a 200 g load.