Supporting Information

Simple and large-scale method to prepare flexible hollow graphene fibers for high performance all-solid fiber supercapacitor

Degang Jiang [a], Jizhen Zhang [b], Chenwei Li [a], Wenrong Yang *[b] and Jingquan Liu *[a]

[a] College of Materials Science and Engineering, Institute for Graphene Applied Technology Innovation, Qingdao University, Ningxia Road 308, Qingdao 266071, China

[b] School of Life and Environmental Sciences, Deakin University, Victoria 3217, Australia

* Corresponding author. E-mail: jliu@qdu.edu.cn and wenrong.yang@deakin.edu.au

Calculations

The Areal capacitances (C_A) and volumetric capacitances (C_V) of one HGF electrode of the HGFS device were calculated from galvanostatic charge/discharge curves using the following equations:

$$C_A = \frac{2I\Delta t}{S\Delta U} \quad (1)$$

$$C_V = \frac{2I\Delta t}{V\Delta U} \quad (2)$$

Where I is the discharge current, S and V are the specific area and volume of one HGF electrode, Δt is the discharge time and ΔU is the voltage change during the discharge process.

The specific energy density (E) and power density (P) of the supercapacitor cell are defined as follows:

$$E_A = \frac{C_A \Delta V^2}{8 \times 3.6} \quad (3)$$

$$P_A = \frac{E_A}{t} \quad (4)$$

$$E_V = \frac{C_V \Delta V^2}{8 \times 3.6} \quad (5)$$

$$P_V = \frac{E_V}{t} \quad (6)$$

C_A and C_V are the Areal capacitances and volumetric capacitances of the whole HGFS device. ΔV (V) is the voltage window, and t (h) is the discharge time, respectively.

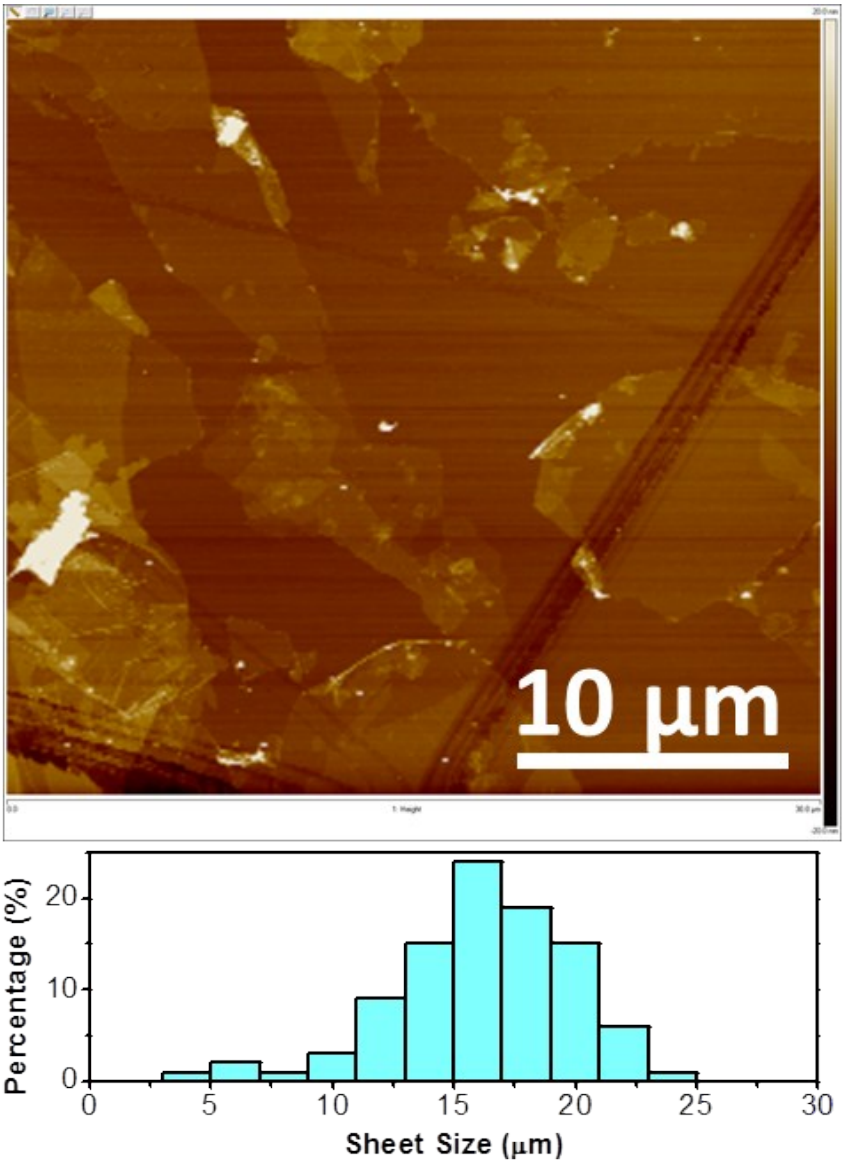

Fig. S1 AFM image of graphene oxide and the sheet size distribution.

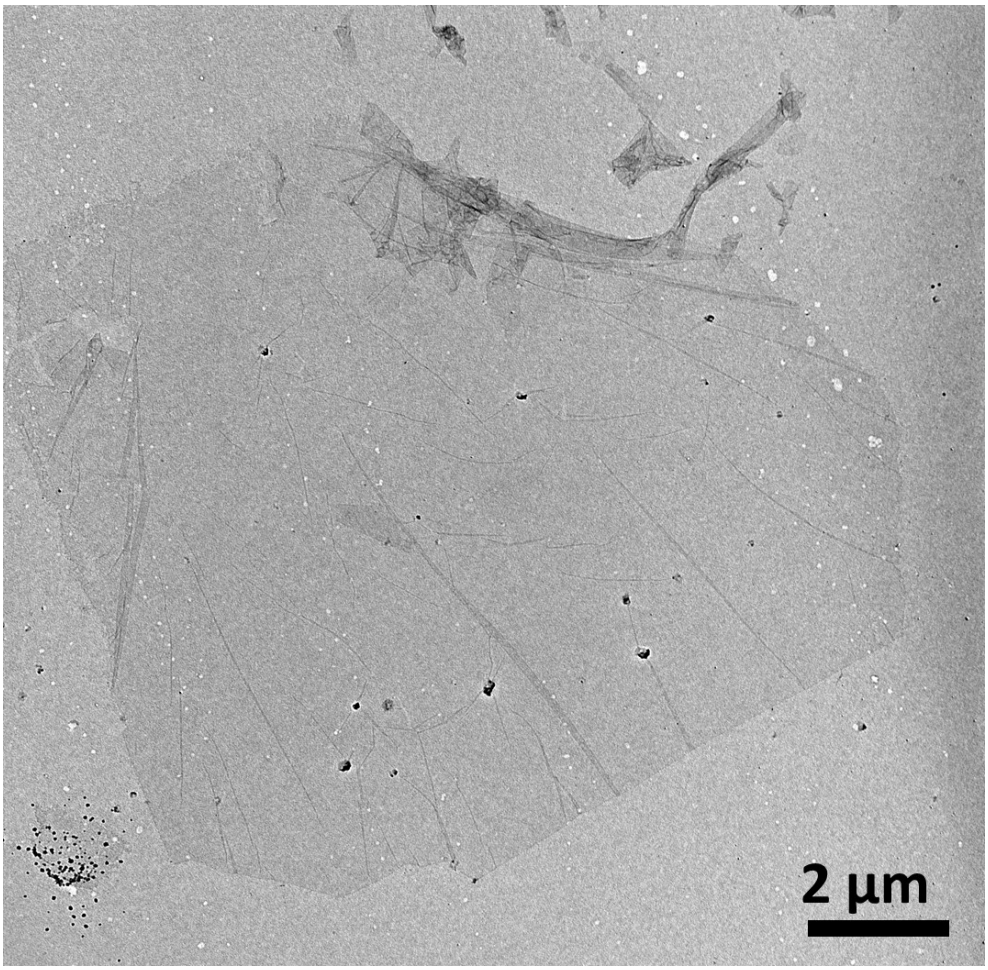

Fig. S2 TEM image of graphene oxide

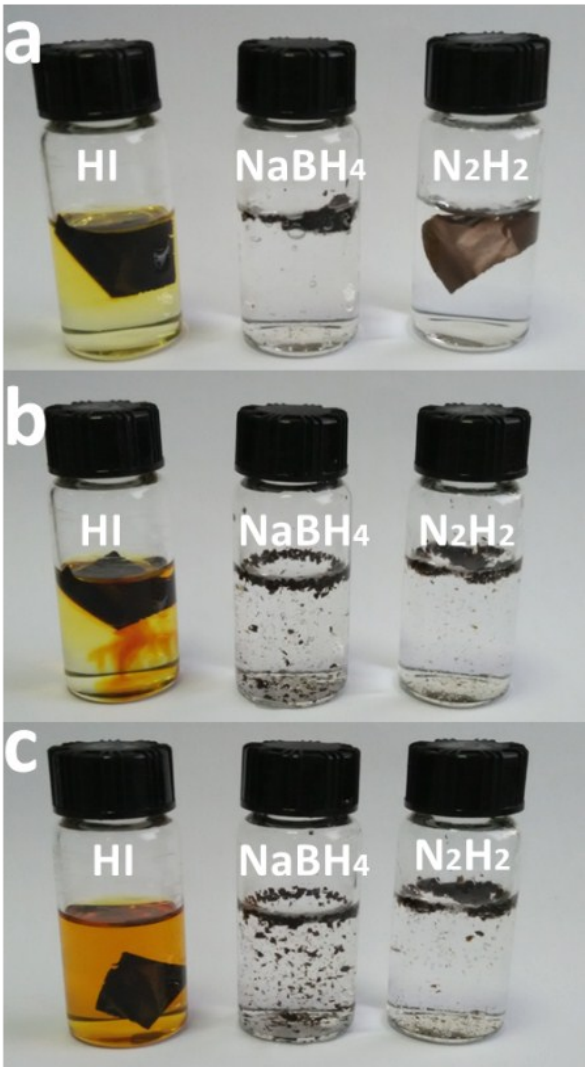

Fig. S3 Visual change of the GO film reduced with different reducing agents for different times at room temperature. Three liquid reducing agents: 40 % HI acid solution (HI), 60 mM $NaBH_4$ aqueous solution ($NaBH_4$) and 80% $N_2H_4 \cdot H_2O$ solution (N_2H_4). (a-c) The GO films were immersed into the reduction agent for 5 seconds, 2h and after shaking the bottles.

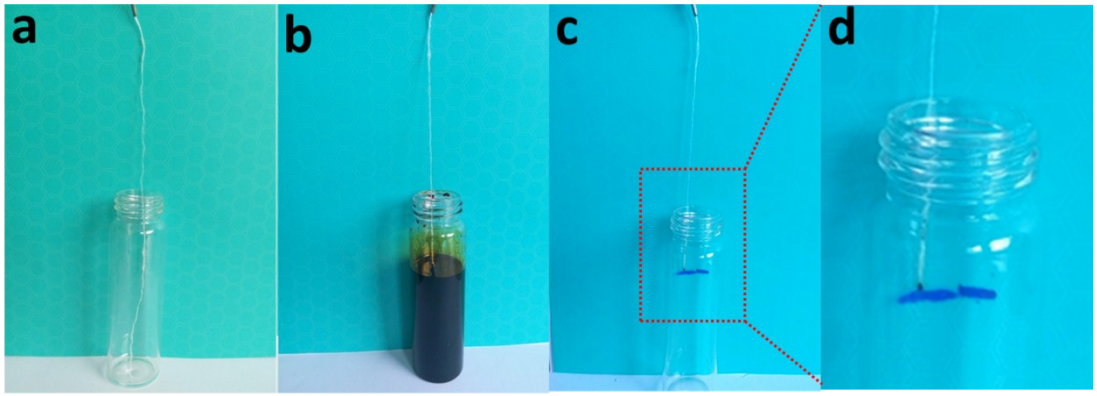

Fig. S4 A mat of silks were immersed in HI before and after 1h in 60 °C. a) Silks before immersing in HI. b) Silks were immersed in HI for 1h in 60°C. c) Silks after immersing in HI. d) Magnification of the photograph of silks after immersing in HI.

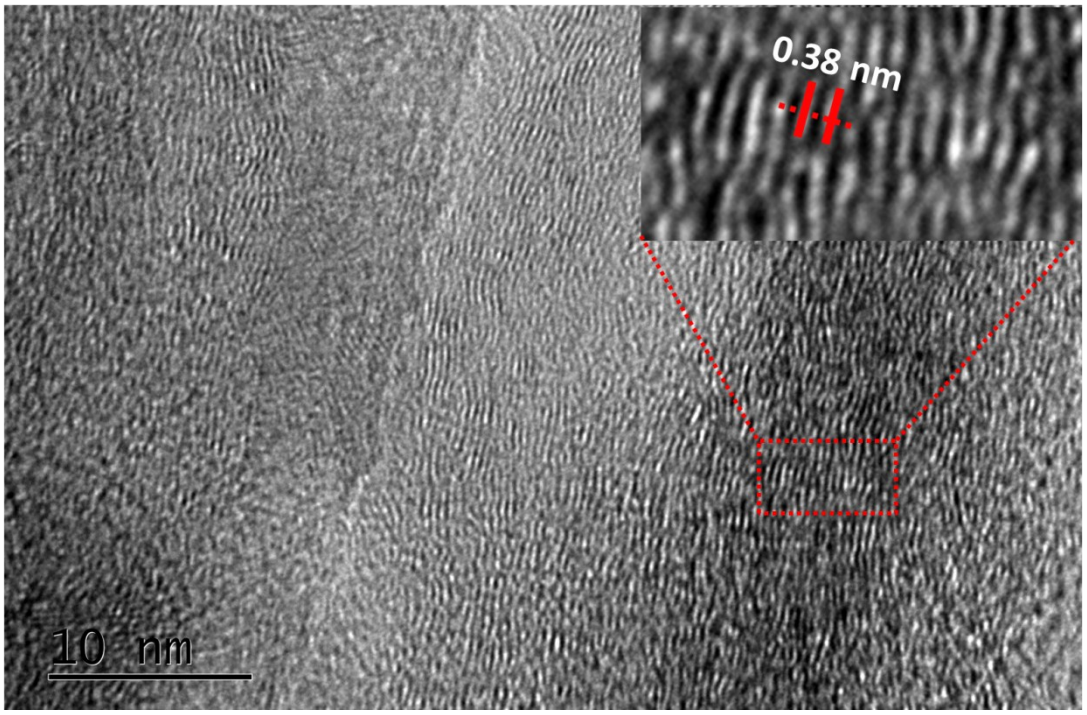

Fig. S5 HRTEM images of the HGFs and the inset was magnificent HRTEM image of HGFs.

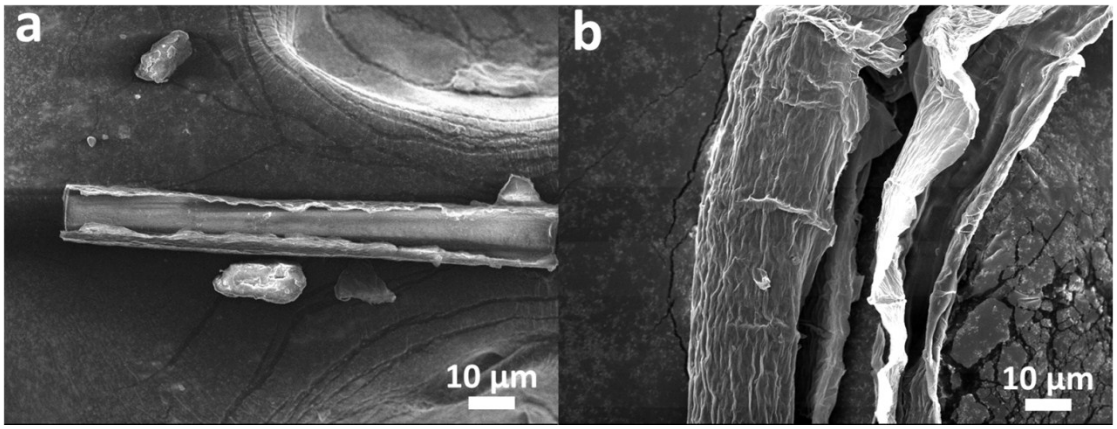

Fig. S6 SEM image of the side-sprayed RGO shell. (a) RGO shell using single silk as template. (b) RGO shell using a few silk fibers as template.

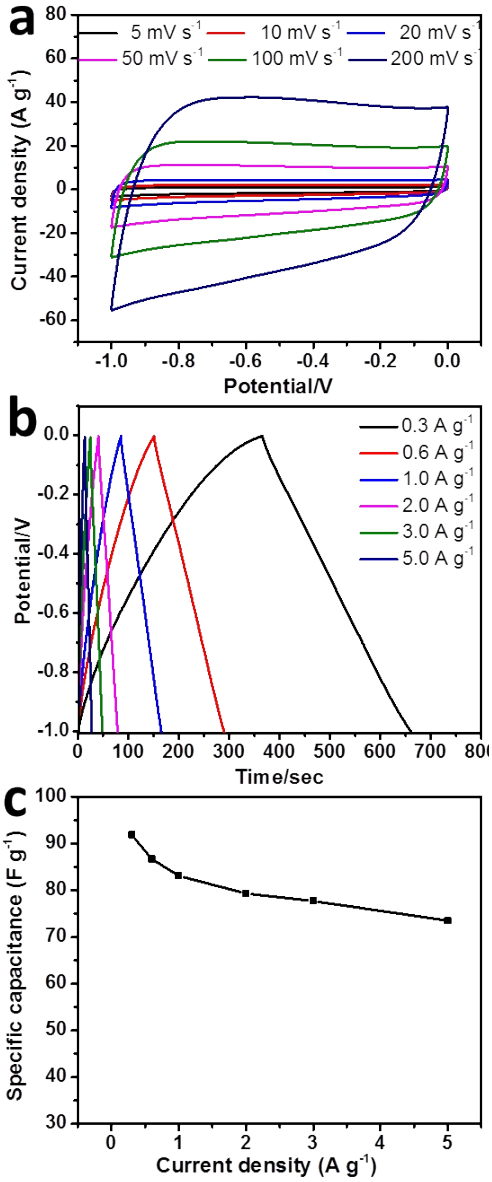

Fig. S7 (a) The CV curves, (b) The GCD curves and (c) specific capacitance of the HGF electrode at different current densities using three-electrode system.

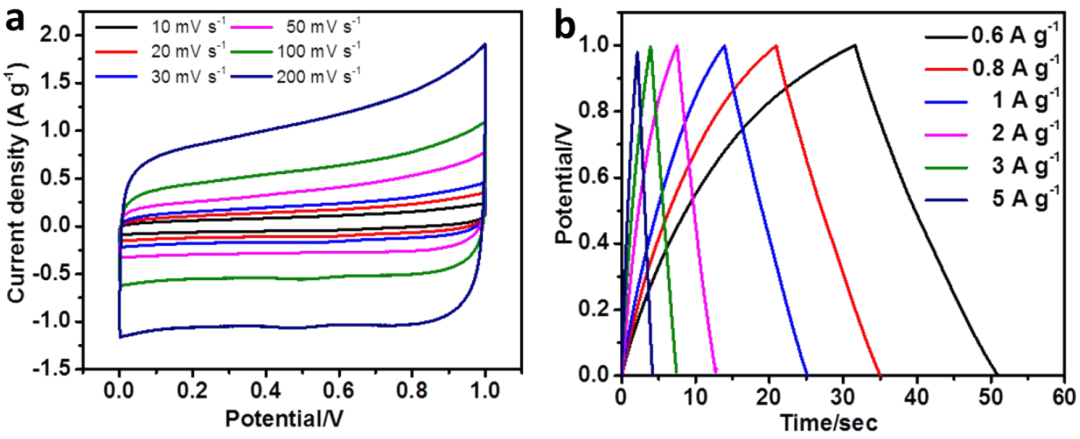

Fig. S8 (a) The CV curves of the GFS at different scan rate. (b) The GCD curves of the GFS at different current densities.

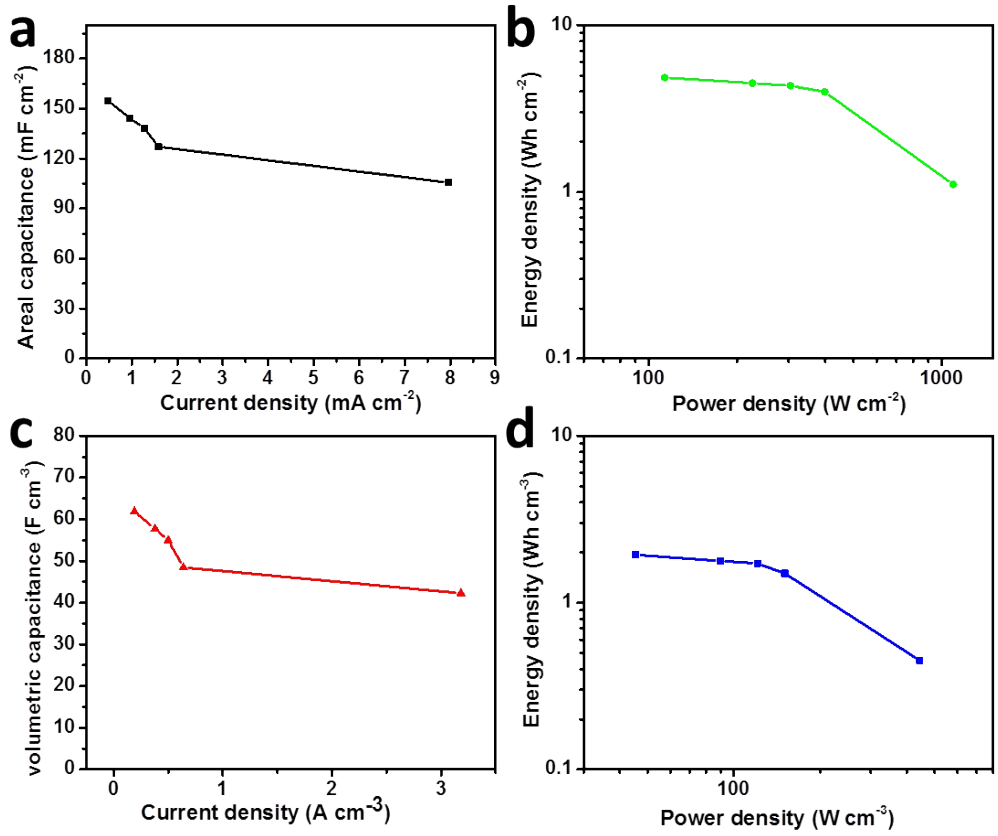

Fig. S9 (a) Areal capacitance of the HGFS at different current densities. (b) Ragone plot of HGFS which was derived from the areal capacitance. (c) Volumetric capacitance of the HGFS at different current densities. (d) Ragone plot of HGFS which was derived from the volumetric capacitance.

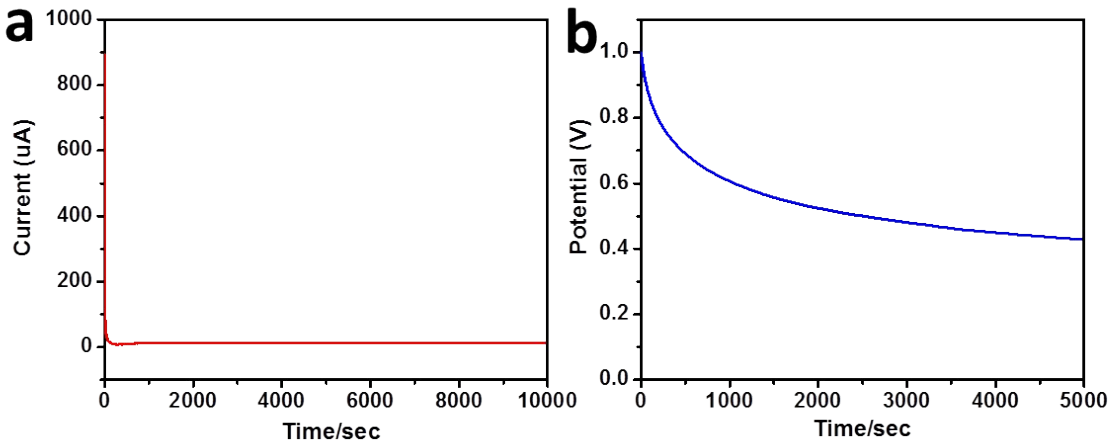

Fig. S10 (a) Leakage current and (b) self-discharge curves of the HGFS device.