Supplementary Information for

Power generation from water flowing through three-dimensional graphene foam

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Synthesis of GF: The GF was synthesized on a scaffold of Ni foam by CVD, the schematic diagram of apparatus used was shown as Fig. S1(a).[1] The Ni foam was put in a round quartz tube, which was inserted into the horizontal tube furnace (~ 32 mm inner diameter) served as sample growth chamber. A transition tube was used to link the air inlet end and the furnace, whose inner diameter was ~ 6 mm. Firstly, the mixture gas of H_2 and Ar was aerated into the quartz tube to drive air out when the temperature in the furnace was raising, H_2 was used for reduction of residual O_2. When the temperature in the furnace reached to ~1000 ℃, heating was stopped, and CH_4 was begun to be aerated into the quartz tube. Carbon atoms were deposited on the Ni foam through CH_4 decomposition under ambient pressure. After growing for about 10 minutes, there was a continuous GF formed as a macroscopic structure with extremely thin interconnected graphene sheets outside the Ni foam. At last, the furnace was cooled down to the common temperature. The graphene sheets grown on the entire surface of the scaffold of Ni foam were interconnected into each other and there was no interface or physical breaks in the network.

SEM of GF: The SEM images (100 ×) of Ni foam and GF, which were shown in Fig. S1(b) and (c), were captured by scanning electronic microscope (Hitachi S4800 + EDS). By comparison, we can easily find that the morphology of GF was different from that of Ni foam, and the surface of GF was coarser but the size of pore was nearly same.

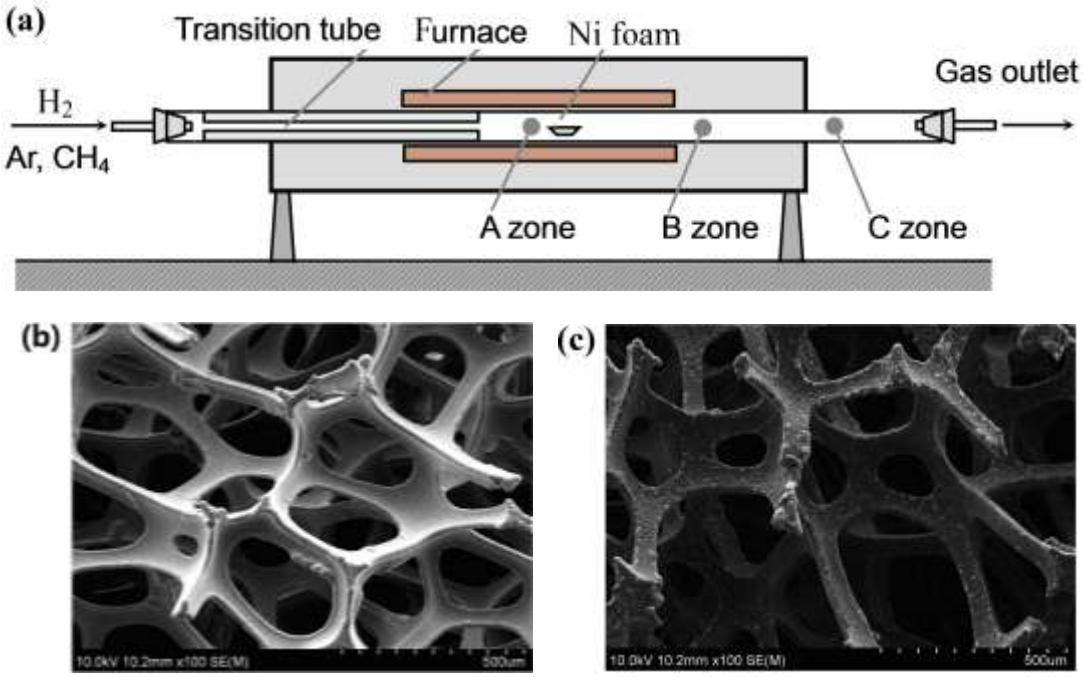

Fig. S1 (a) Schematic diagram of the apparatus used for synthesizing three-dimensional grpahene on Ni foam by CVD; (b) SEM image of Ni foam; (c) SEM image of three-dimensional grpahene on Ni foam.

Raman spectra of graphene foam: As shown in Fig. 2S(a), there are typical Raman spectra of GF. From bottom to up, the intensity ratios of the G and 2D modes (I_{2D}/I_G) of the as-grown GF show that the walls of GF are comprised of monolayer, bilayer, trilayer and multi-layer graphene sheets, respectively.[2] The strongly-suppressed defect-related D band confirms high quality (defect-free) of the graphene grown by CVD.[3] In the analysis, the I_{2D}/I_G of 49 points among all 50 counted ones lie between 1.5 and 3.0, indicating ~ 98% are covered by monolayer, bilayer and trilayer graphene. The histogram of layers of GF samples is shown as Fig. 2S (b).

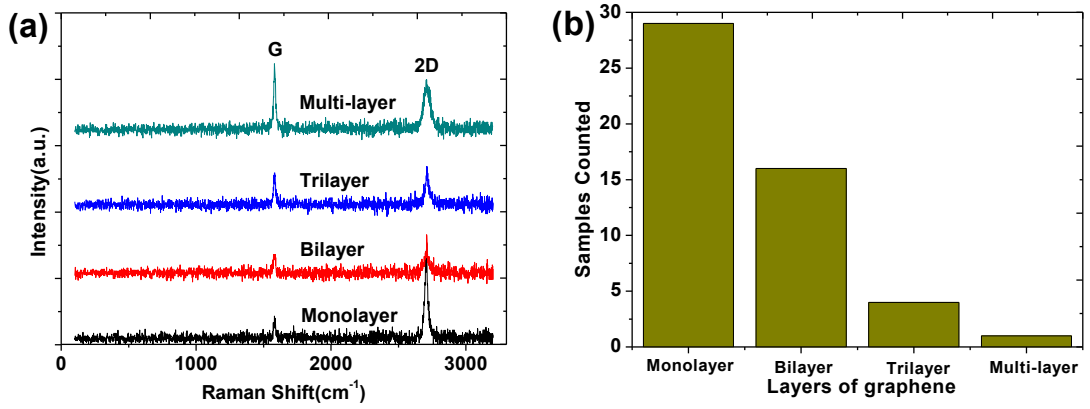

Fig. S2 (a) Raman spectra of three-dimensional grpahene on Ni foam; (b) Histogram of layers of three-dimensional grpahene on Ni foam, which indicates that ~ 98% of three-dimensional grapheme are few-layer (monolayer, bilayer and trilayer coverage).

Measuring Contact angle of water on graphene foam: To investigate the surface wettability of GF, contact angle and volume of distilled water droplet (3μL) were measured by sessile-drop method on a Dataphysics OCA20 CA system at room temperature.[4] Firstly, a drop of liquid was deposited with a micro syringe onto the dry GF in air. Images of drops were captured, and the experimental profile of each drop was extracted. Then, the three-phase contact points were identified, which was a highly delicate process. The Young-Laplace theoretical model based on axisymmetric drop shape analysis was selected and the tangent line of the goniometer was adjusted to the contact points to obtain the contact angle automatically. This technique often resolves contact angles with an accuracy of ~ 0.2°. The volume of liquid was also calculated using the same theoretically calculated model by automatic computer image recognition technique.

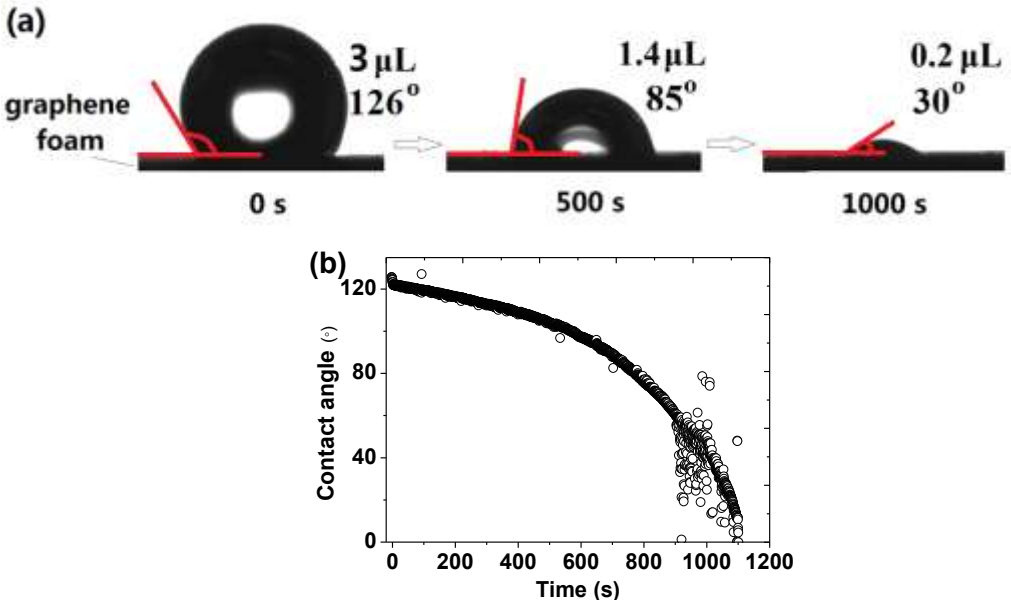

Fig. S3 (a) Cross-sectional views of water droplet on three-dimensional graphene, the volumes and contact angles at 0 s, 500 s and 1000 s are shown; (b) The variation curves of contact angle of water droplet lying on the surface of graphene foam.

References:

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