Cotton-Derived Bulk and Fiber Aerogels Grafted with Nitrogen-Doped Graphene

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Supplementary Information:

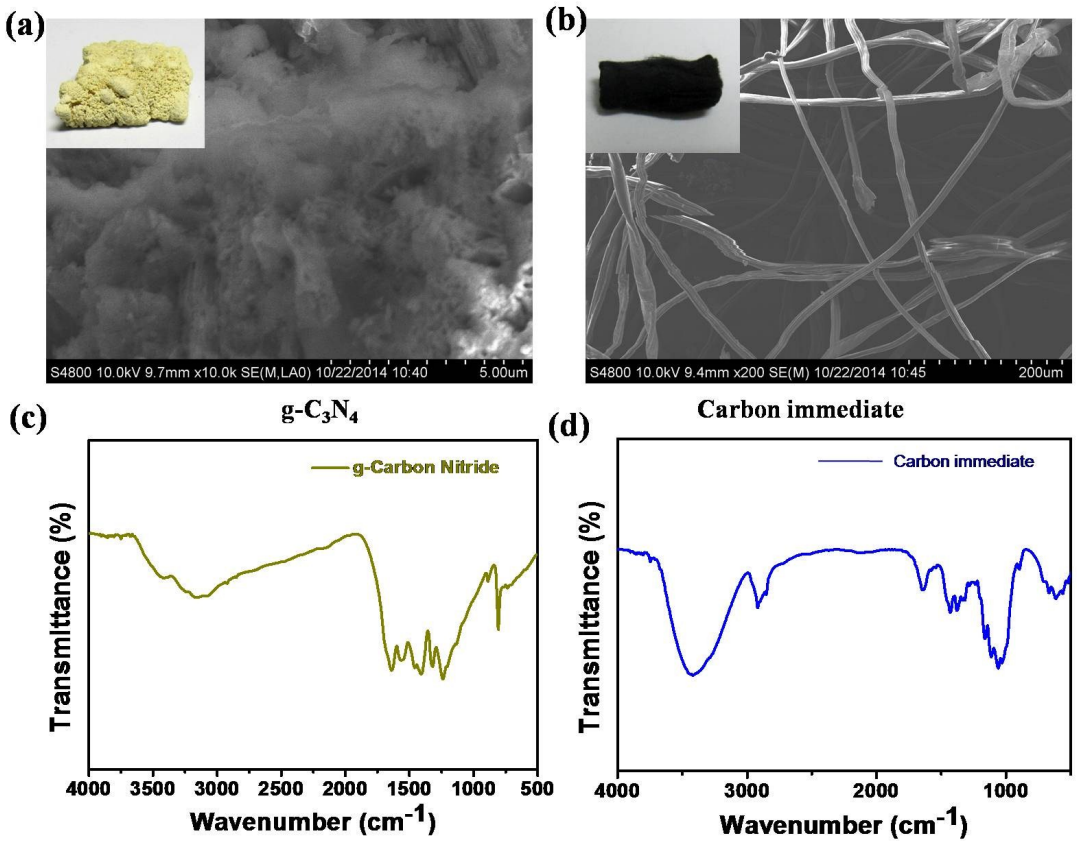

Figure S1. a, b) g-C_3N_4 and carbon immediate produced from urea and raw cotton at 500-600 ℃, respectively. c,d) FT-IR spectrum of a) and b).

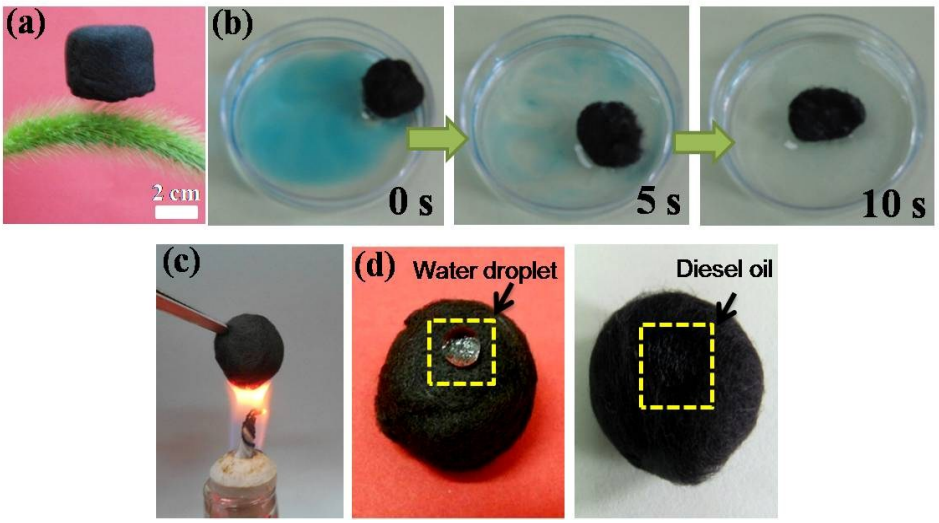

Figure S2. a) A cylindrical CF@N-G aerogel (ρ = 14 mg cm^{-3}) stands on a dog's tail-like flower. b) Sorption of organic liquids by CF@N-G aeroel. c) Photograph of CF@N-G aerogel in a hot flame of an alcohol burner.. d) A water drop stands on the aerogel while the oil drop is adsorbed by the aerogel. e, f) g-C_3N_4 and carbon immediate produced from urea and raw cotton at 500-600 ℃, respectively.

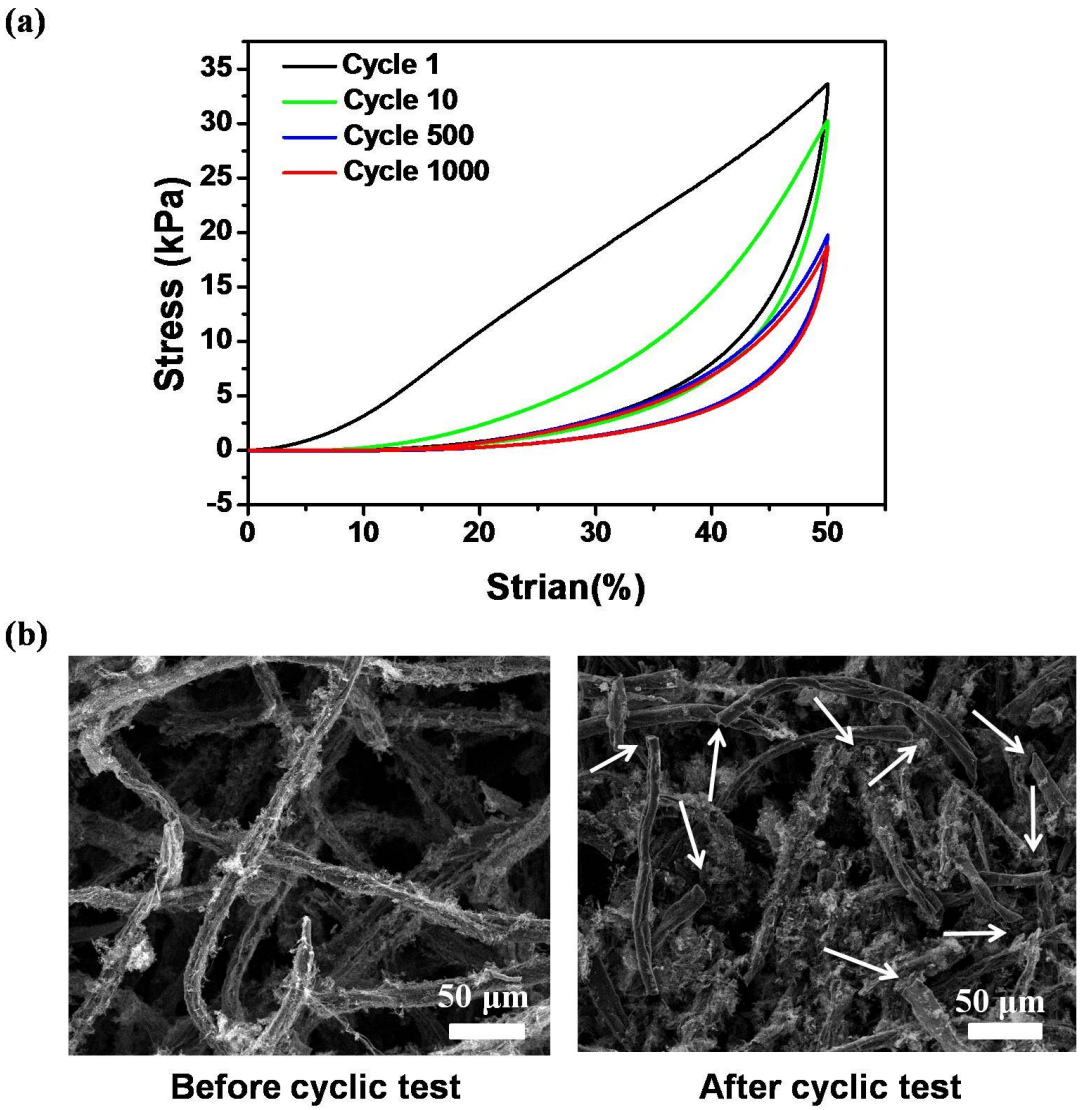

Figure S3. a) The stress-strain curves of CF@N-G aerogel at the maximum strain of 50% for 1000 cycles. b) The interior structure of sample a) before and after the cycling tests.

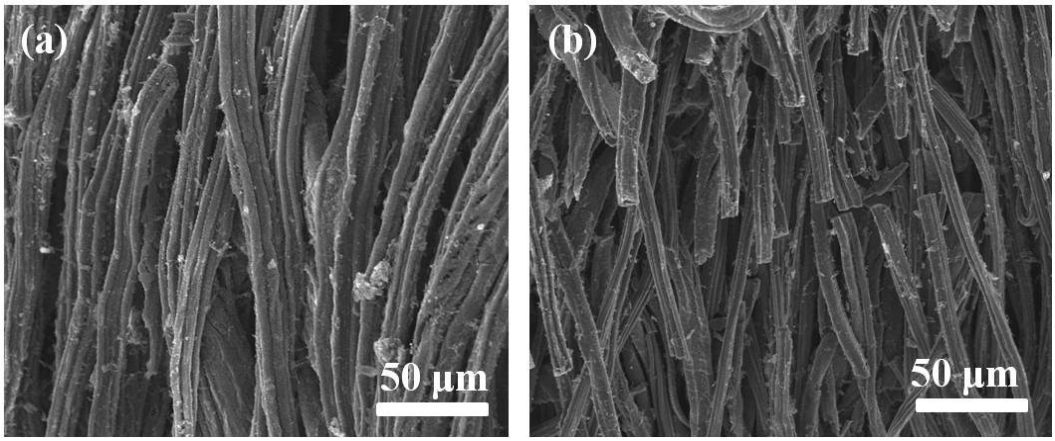

Figure S4. a) Morphology of CF@N-G fiber-shaped aerogel. b) Morphology of helix CF@N-G fiber. Carbon fibers are broken because of twist.

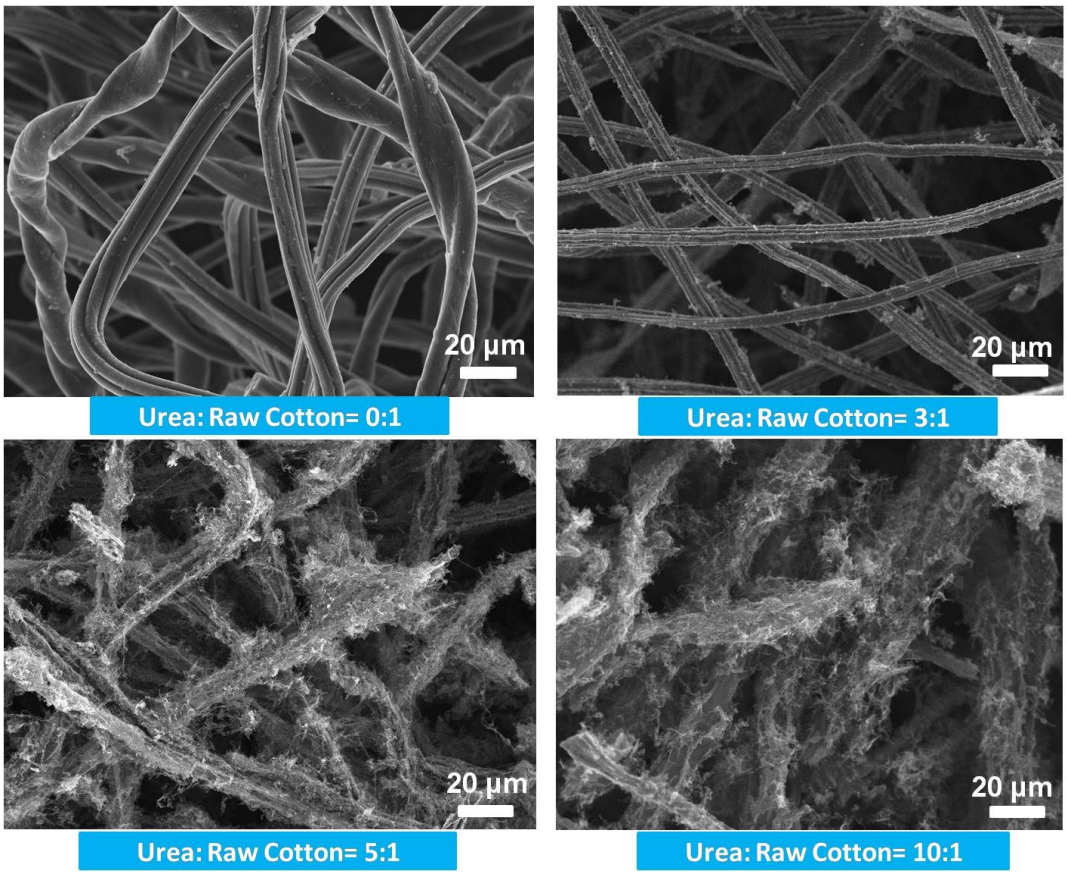

Figure S5. Morphology of CF@N-G aerogel fabricated by different ratios of raw cotton and urea.

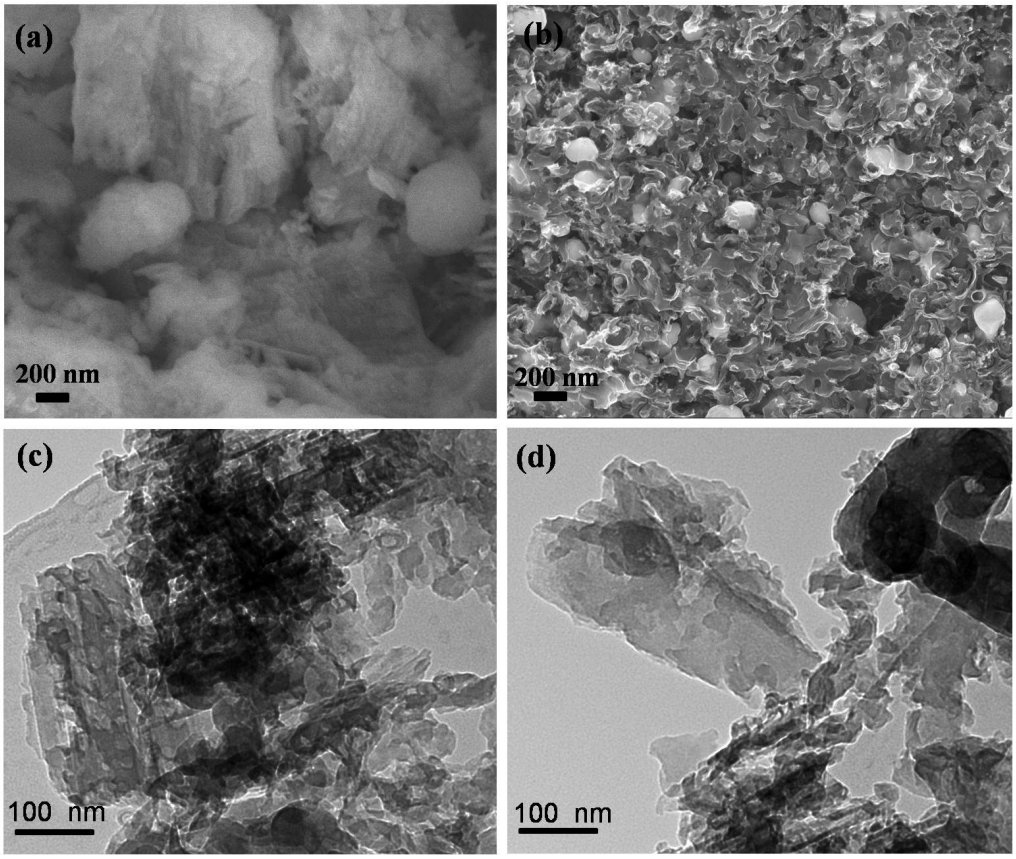

Figure S6. a) SEM image of g-C_3N_4. b) Product of urea heated without raw cotton under the same conditions as synthesis of CF@N-G. c) TEM image of g-C_3N_4. d) TEM image of product b).

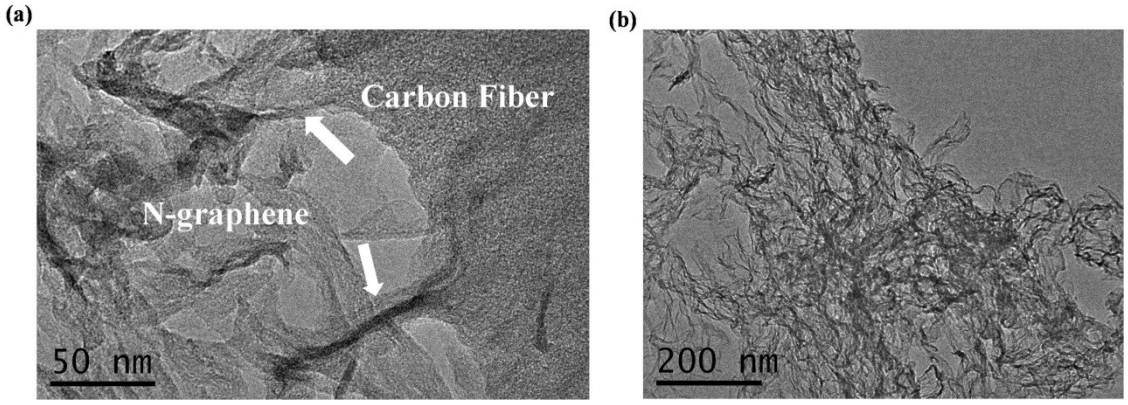

Figure S7. TEM images of a) N-graphene grafted to carbon fiber. As the white arrow points, N-graphene grow directly from the plane of carbon fiber, indicating the carbon-carbon bonding. b) The as-prepared nitrogen-doped graphene nanosheet.

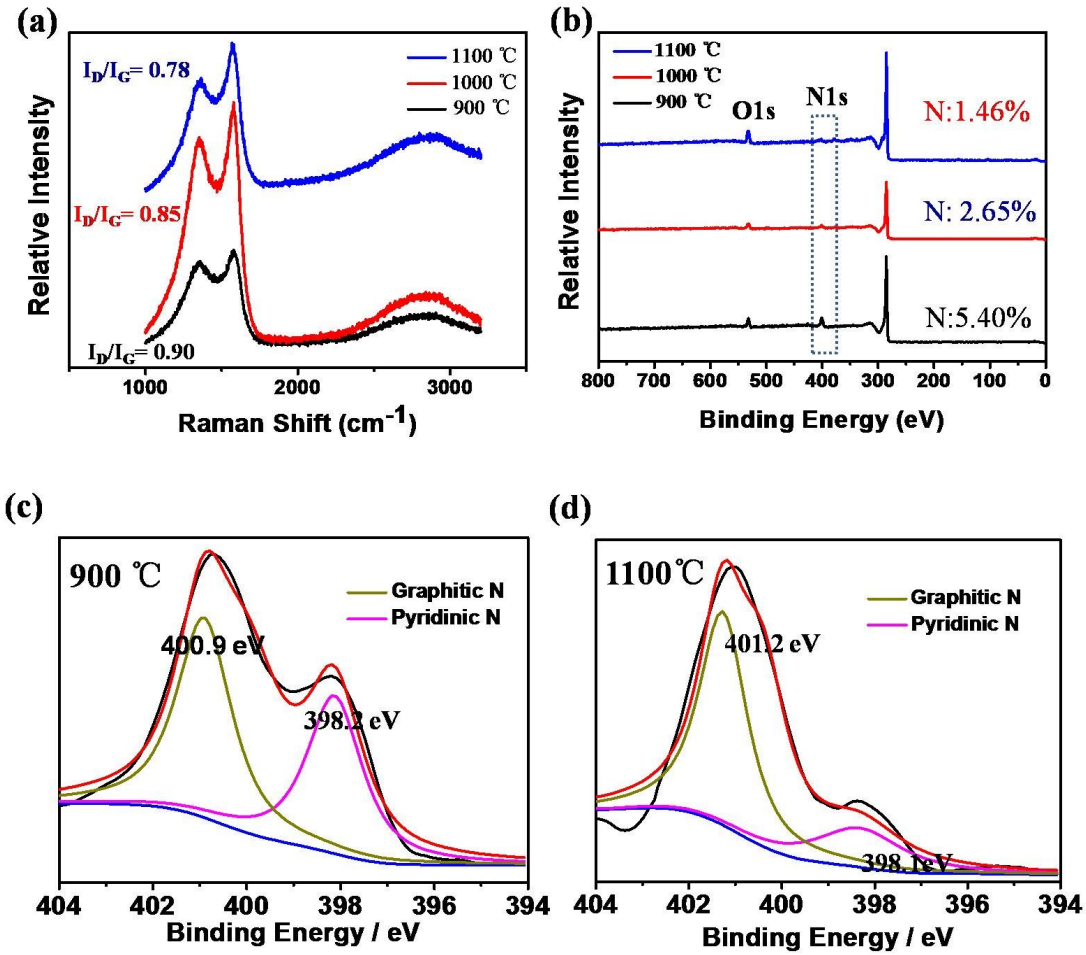

Figure S8. a) Raman spectrum CF@N-G synthesized under different temperature. b) XPS survey spectrum of CF@N-G synthesized under different temperature. c, d) High-resolution N1s XPS spectra of CF@N-G at different synthesis temperature.

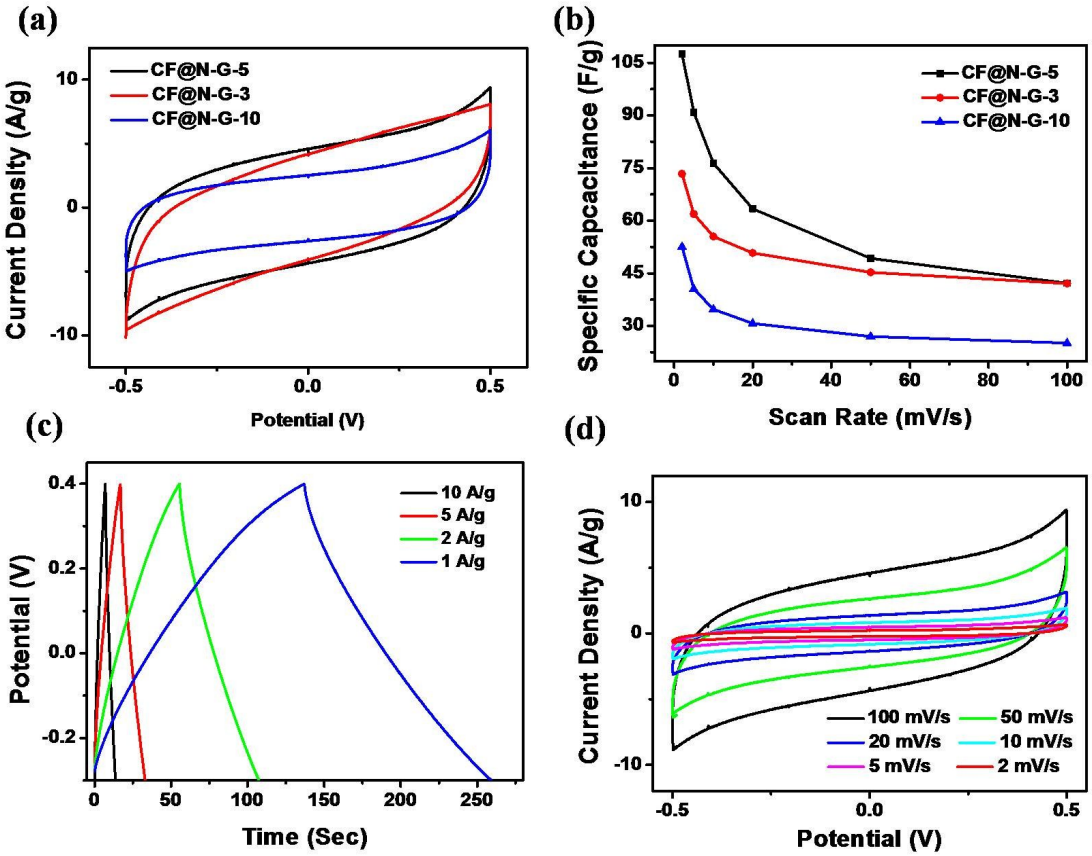

Figure S9. Electrochemical performances of CF@N-G//CF@N-G-based supercapacitor measured in a two-electrode system. a) CVs of CF@N-G-3, CF@N-G-5 and CF@N-G-10 devices at 100 mV/s in 6 M KOH aqueous solution. b) Calculated specific capacitances of the CF@N-G-3, CF@N-G-5 and CF@N-G-10 devices. c) Galvanostatic charge-discharge curves of CF@N-G-5//CF@N-G-5 device at a current density of 1, 2, 5, and 10 A/g. d) CVs curves of CF@N-G-5//CF@N-G-5 device at different scan rates.

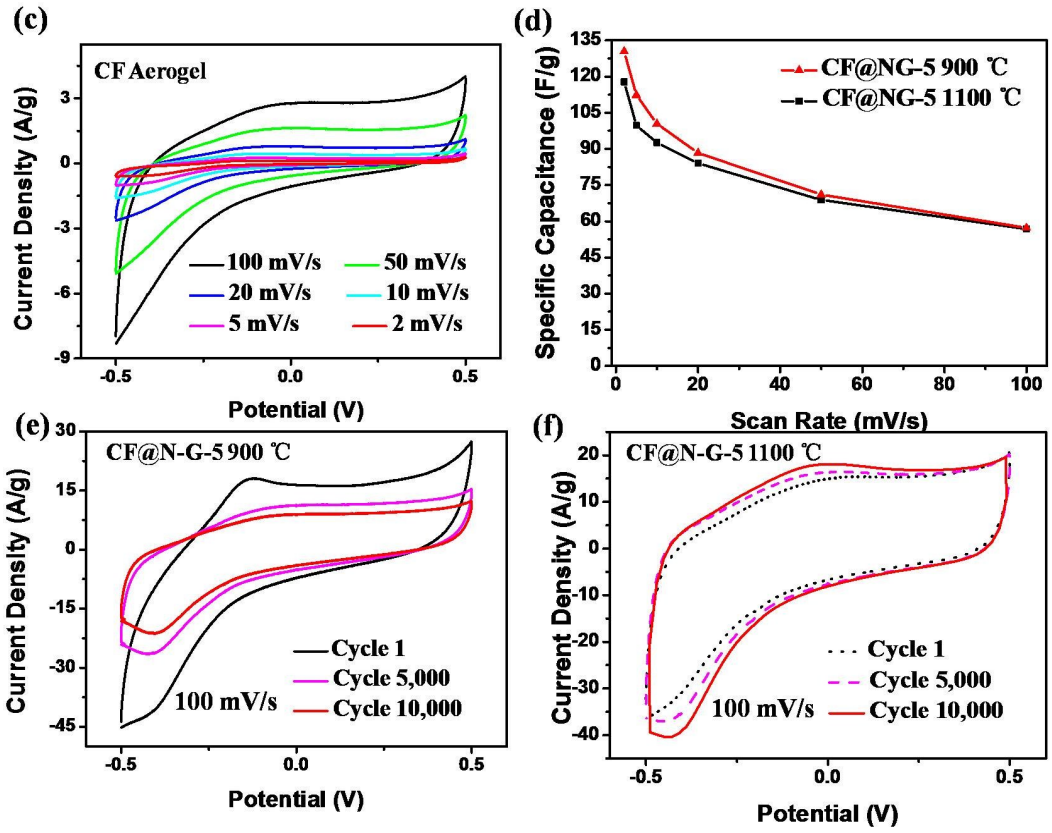

Figure S10. a) CVs of CF Aerogel electrode at different scan rate in 6 M KOH aqueous solution. b) Calculated specific capacitances of the CF@N-G-5 900 °C and 1100 °C electrodes. c, d) The CV curves of CF@N-G-5 900 °C and 1100 °C electrodes for cycle 1, 5000, 10000, repectively.

Table S1. Electrochemical performance of different N-doping graphene aerogels (hydrogels)

Starting materials	N-doping method	Specific capacitance	Conditions	Cycling retention	Reference
GO+Pyrrole (Aerogel)	1.Hydrothermally treated;2.Annealed	484 F g^{-1}	Three-electrode (1 A g-1, 1 M LiClO4)	100% (1000 cycles)	**1**
GO+NH3BF3 (Aerogel)	Hydrothemally treated at 180 □	190 F g^{-1}	Three-electrode(1 mV/s, PVA/H2SO4)	110% (1000 cycles)	**2**
GO+CNTs +Pyrrole (Aerogel)	Hydrothermal process	180 F g^{-1}	Two-electrode(0.5 A g-1, 6 M KOH)	96% (3000 cycles)	**3**
GO+Ammonia (Aerogel)	Hydrothermal process	223 F g^{-1}	Two-electrode(0.2 A g-1, 1 M H2SO4)	92% (2000 cycles)	**4**
GO+Organic Amine (Hydrogel)	Hydrothermal process	190.1 F g^{-1}	Two-electrode(10 A g-1, 5 M KOH)	95.2% (4000 cycles)	**5**
GO+Pyrrole (3D framework)	1. Solution-based Polymeration; 2. Aneealed	335.7 F g^{-1}	Three-electrode(1 mV/s, 1 M H2SO4)	99.5% (1000 cycles)	**6**
GO+Organic Amine (Hydrogel)	Solvothermal Reaction	301 F g^{-1}	Two-electrode(0.1 A g-1, 6 M KOH	97.1% (4000 cycles)	**7**
Raw Cotton+ Urea(Aerogel)	Thermal Anealling	107.5 g^{-1}	Two-electrode(2 mV/s, 6 M KOH	120% (10,000 cycles)	**This work**

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