Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A

Supporting Information For

Synthesis and characterization of nitrogen-doped graphene hydrogels by hydrothermal route with urea as reducing-doping agents

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1 Measurement of the specific surface areas (SSAs) of RGO and nitrogen-doped graphene hydrogels (NGHs) samples: MB adsorption is a standard method for measuring the SSAs of graphitic materials [1,2]. However, the standard MB method is designed for powdery materials. To measure the SSAs of RGO and NGHs samples in wet state, this method was modified as follows. The water contained in the hydrogel will dilute the standard MB solution during the adsorption test; therefore, the actual MB concentration should be corrected. Since NGHs contain > 97 % water, the mass of water in the hydrogel nearly equals to the total mass of NGHs. The standard density of water was 1 g mL^{-1} and the density of water was used in calculation.

A MB aqueous solution (2 mg mL^{-1}) was used as the standard probe and the working curve were collected after diluting it for 200, 150, 100, or 50 times. A piece of NGHs (about 50 to 100 mg in wet state) was cut and blotted with a filter paper to remove excess water, then it was immersed in MB solution (2.00 mL, 2 mg mL^{-1}) in a glass vial (2.5 cm in diameter) for 24 h at room temperature for achieving an adsorption equilibrium. Subsequently, MB solution (15 μL) was got from the vial and diluted to 3.0 mL for measuring its light absorbance at 665 nm (UV-1700 UV-VIS spectrometer, Shimadzu). Finally, the concentration of MB solution at adsorption equilibrium (c_{MB}) can be calculated from its absorbance by referring to the working curve.

The SSA of NGHs was calculated by using following equations:

$$SSA\ (m^2\ g^{-1}) = 2.54 \times M_{MB} / M_{NGHs} \quad (1)$$

The constant 2.54 is the literature value of the surface area (m^2) covered by 1.0 mg of adsorbed MB[1,2]; M_{MB} is the mass change of MB in the equilibrium solution calculated by using the equation of $M_{MB} = 2\times2 - c_{MB} \times (2.00 + M_{NGHs\ in\ wet\ state})$.

2 Supporting figures

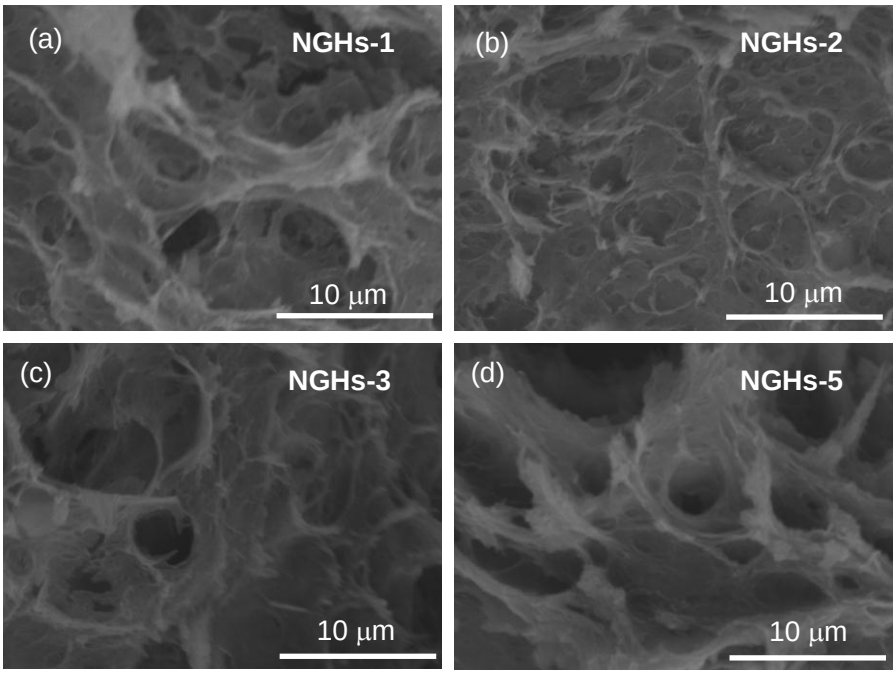

Fig. S1 SEM images of freeze-dried (a) NGHs-1, (b) NGHs- 2, (c) NGHs-3 and (d) NGHs-5.

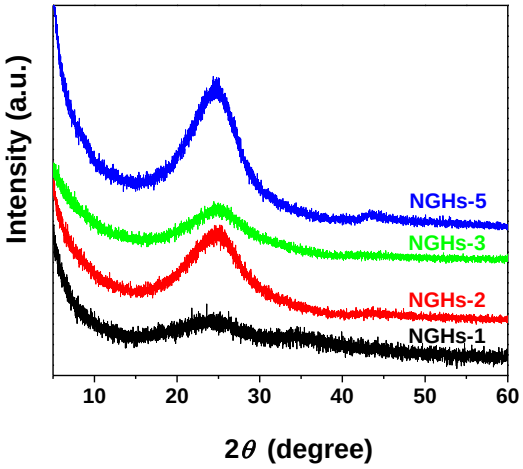

Fig. S2 XRD patterns of NGHs-1, NGHs-2, NGHs-3 and NGHs-5 samples.

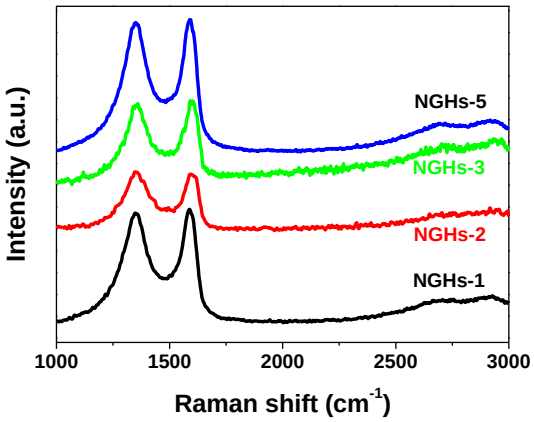

Fig. S3 Raman spectra of NGHs-1, NGHs-2, NGHs-3 and NGHs-5 samples.

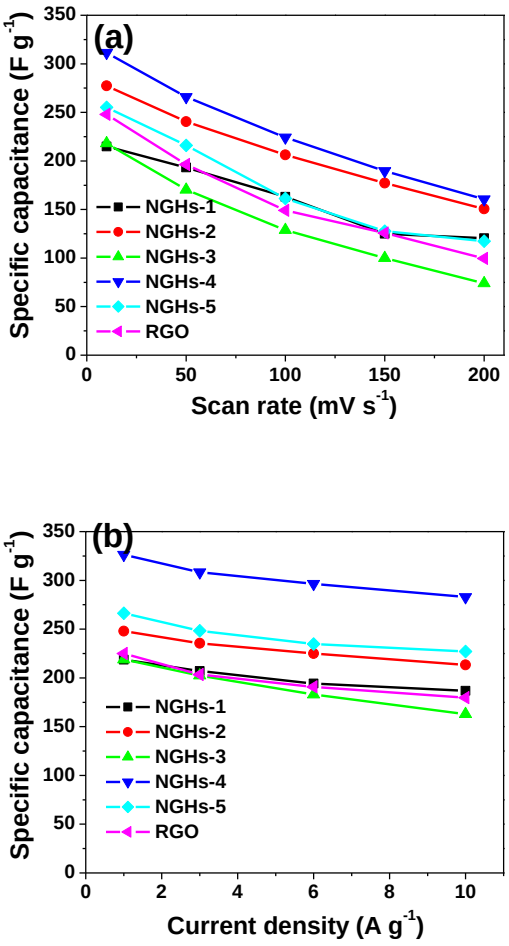

Fig. S4 Relationship of the specific capacitance with respect to the scan rate (a) and current density (b) for NGHs-1, 2, 3, 4, 5 and RGO.

References

1 J. Chen, K. X. Sheng, P. H. Luo, C. Li and G. Q. Shi, Graphene hydrogels deposited in nickel foams for high-rate electrochemical capacitors, *Adv. Mater.*, 2012, **24**, 4569-4573.

2 M. McAllister, J.-L. Li, D. H. Adamson, H. C. Schniepp, A. A. Abdala, J. Liu, M. Herrera-Alonso, D. L. Milius, R. Car, R. K. Prudhomme and I. A. Aksay, Single sheet functionalized graphene by oxidation and thermal expansion of graphite, *Chem. Mater.*, 2007, **19**, 4396-4404.