Supporting Information

Amine-Functionalized Holey Graphene as a Highly Active Metal-Free Catalyst for Oxygen Reduction Reaction

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Content:

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Figure S5. LSV curves at different potentials and K-L plots of (a,b) Graphene, (c,d) NG, and (e,f) JM-Pt/C-40 wt.%.

Preparation of thermally reduced GO (graphene). The thermal reduction of GO has been done using a procedure reported previously.[1, 2] Briefly, the dry GO is loaded in an alumina crucible and is then placed in a simple horizontal tube furnace, which is then heated to 800 °C in a nitrogen atmosphere with heating rate of 5 °C min^{-1}. After 1 h, it is cooled to room temperature, and the obtained product is graphene.

Preparation of nitrogen-doped graphene (NG). NG is obtained using a procedure similar to that reported with a slight modification:[3] Typically, 40 mg of GO is first dispersed in 40 mL of H_2O by sonication, and 0.2 g of melamine is then mixed. The obtained mixture is stirred until significant agglomeration is observed. The agglomeration is then transferred to a Teflon lined autoclave for the hydrothermal reaction at 180 °C. After 12 h, it is cooled to room temperature. The obtained solution is filtrated and dried at 80 °C in an oven. The solid material is collected and homogenized into fine powders using a mortar and pestle. The obtained powders are then pyrolyzed at 800 °C for 1 h in a nitrogen atmosphere to fabricate NG.

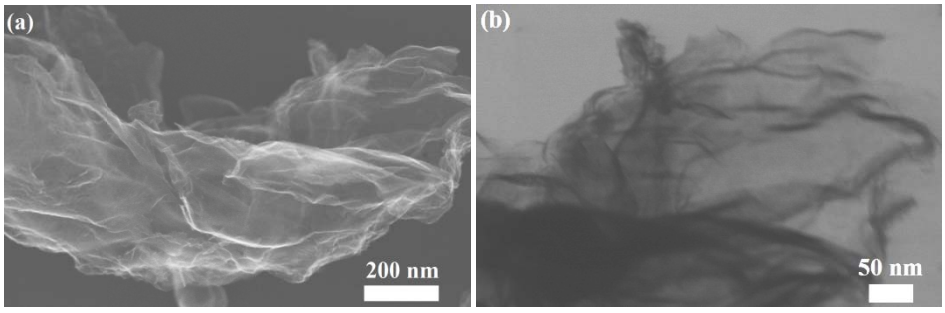


Figure S1. SEM (a) and TEM (b) images of graphene.

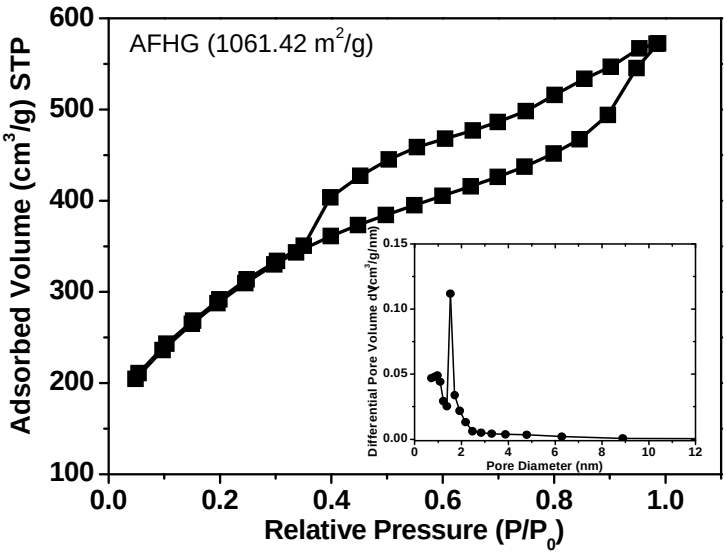


Figure S2. Nitrogen adsorption–desorption isotherms of the AFHG, with the inset showing the pore-size distribution. The specific surface areas of the samples were calculated using the Brunauer–Emmett–Teller (BET) method with the adsorption data at the relative pressure (P/Po) range of 0.05–0.2. The pore size distribution plot calculated by BJH method using desorption branch of the isotherms.

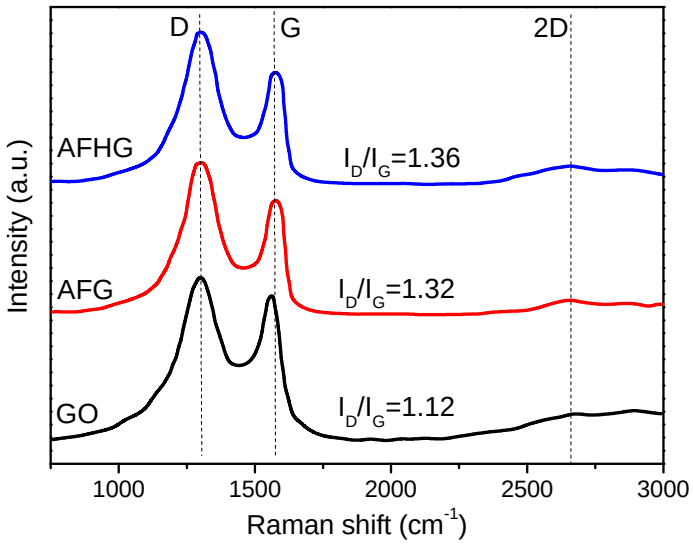


Figure S3. Raman spectra of GO, AFG, and AFHG.

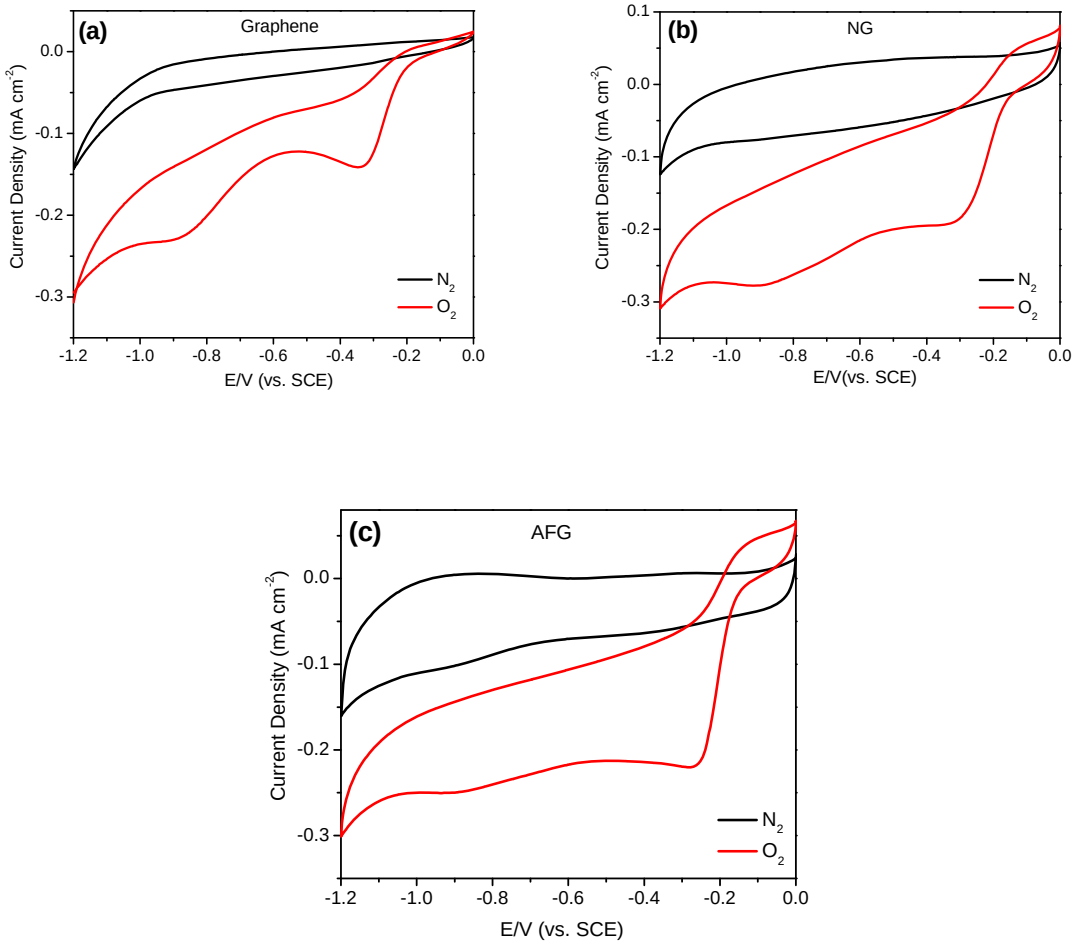
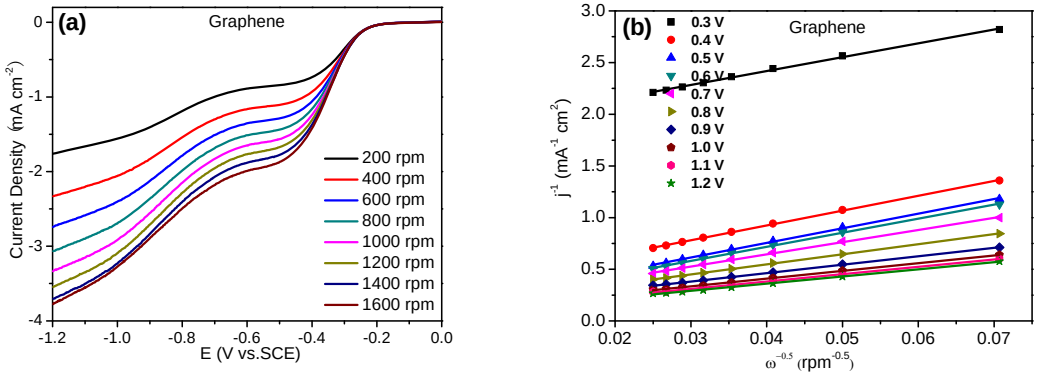


Figure S4. CVs of electrodes in the N_2 and O_2-saturated 0.1 M KOH solutions at a scan rate of 10 mV s^{-1}: (a) Graphene (b) NG, and (c) AFG.



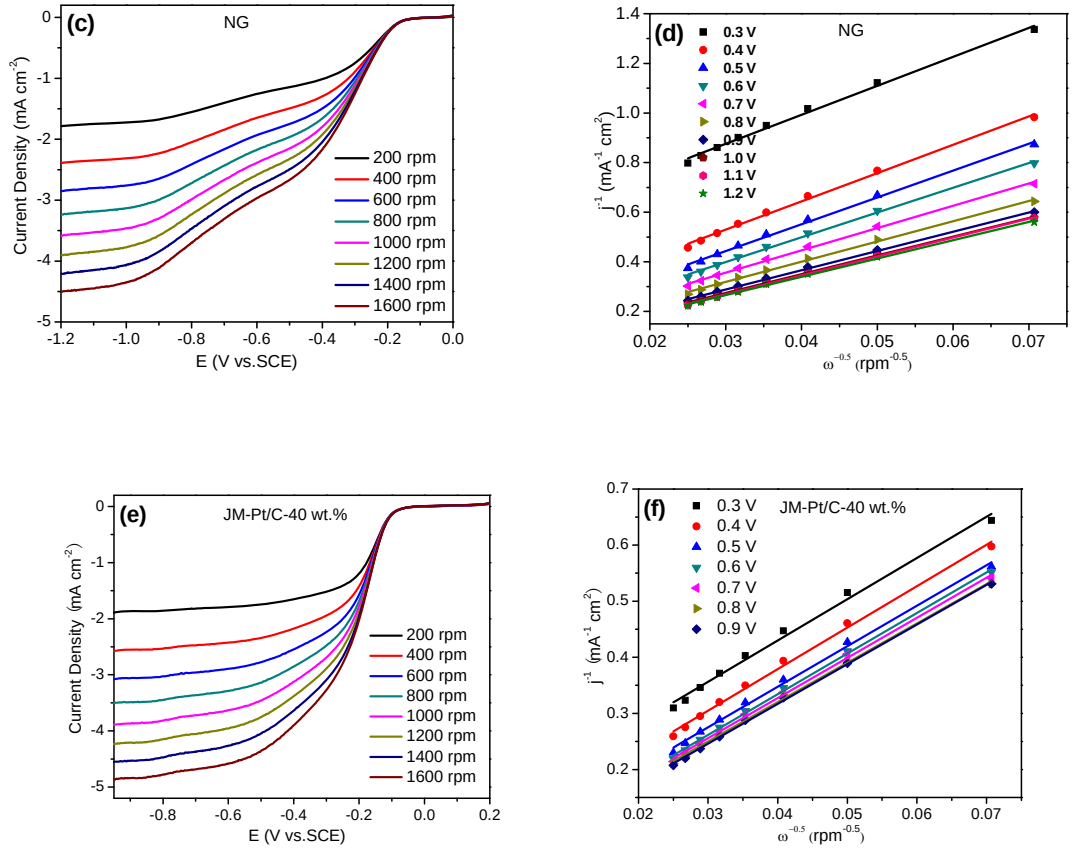


Figure S5. LSV curves at different potentials and K-L plots of (a,b) Graphene, (c,d) NG, and (e,f) JM-Pt/C-40 wt.%.

REFERENCES

1. Q. Du, M. Zheng, L. Zhang, Y. Wang, J. Chen, L. Xue, W. Dai, G. Ji and J. Cao, *Electrochim. Acta*, 2010, **55**, 3897-3903.

2. B. Zhao, P. Liu, Y. Jiang, D. Pan, H. Tao, J. Song, T. Fang and W. Xu, *J. Power Sources*, 2012, **198**, 423-427.

3. Y. Sun, C. Li and G. Shi, *J.Mater.Chem.*, 2012, **22**, 12810.