Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information for:

Pyridinic and Graphitic Nitrogen-rich Graphene for High-Performance Supercapacitor and Metal-free Bifunctional Electrocatalyst for ORR and OER

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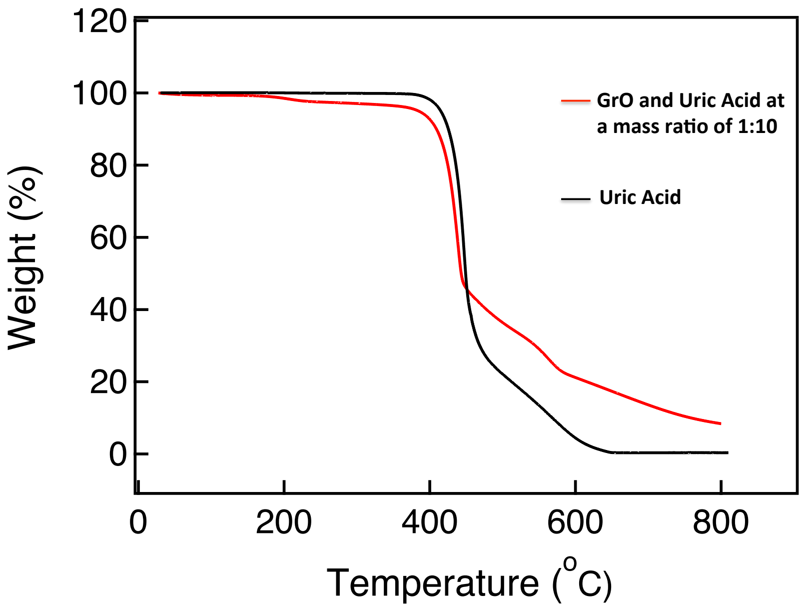

Figure S1. Thermogravimetric analysis of an as-prepared GO–uric acid composite at a rato of 1:10 by mass and uric acid only. The composites were heated at 5 ºC min^{-1} under flowing argon.

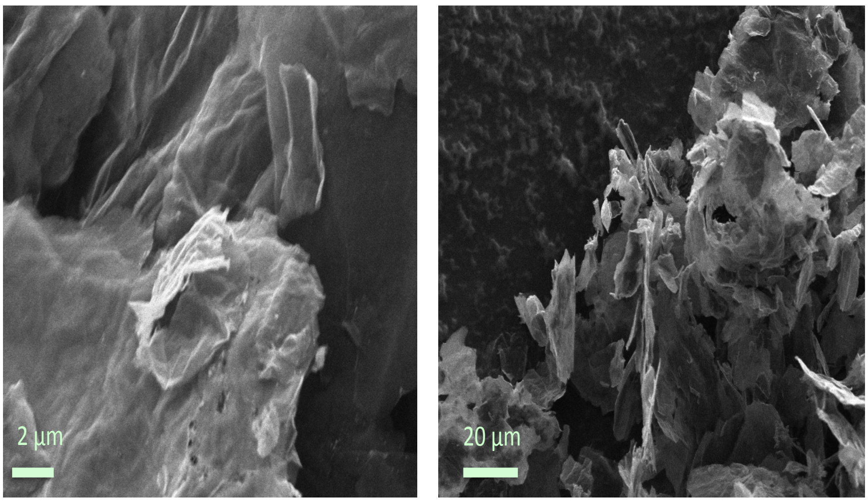

Figure S2. SEM images of NG1 and NG5.

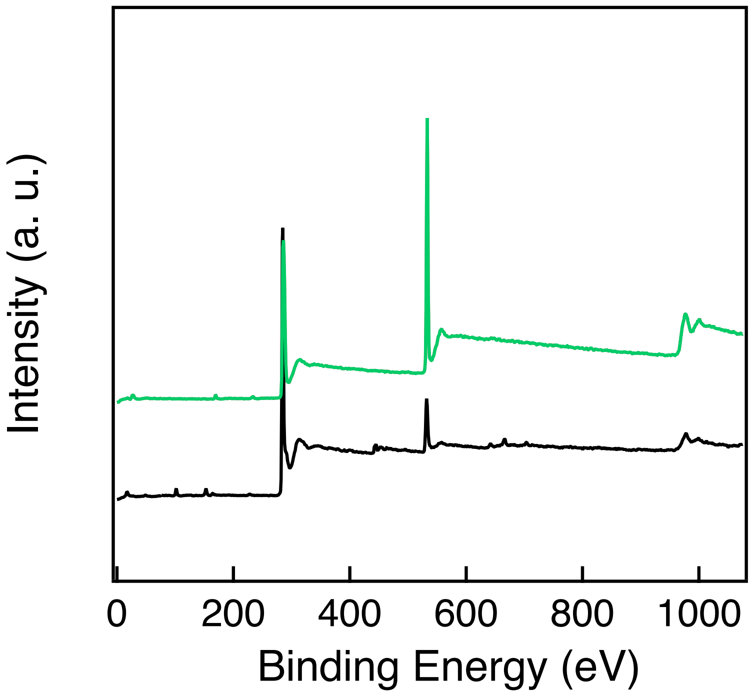

Figure S3 XPS spectra of GO (green) and rGO (black).

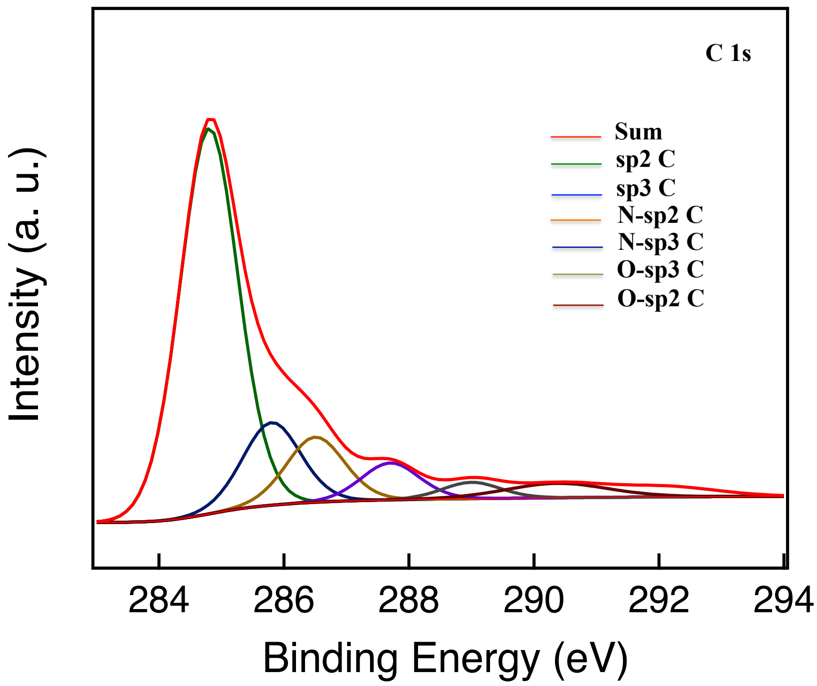

Figure S4. High resolution C1*s* XPS spectra of NG5.

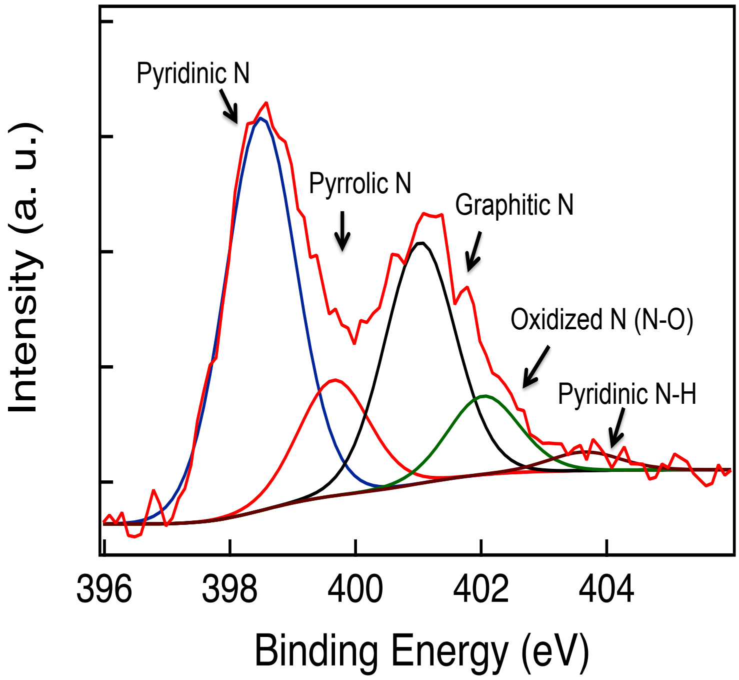

Figure S5. High resolution N1*s* XPS spectra of NG5.

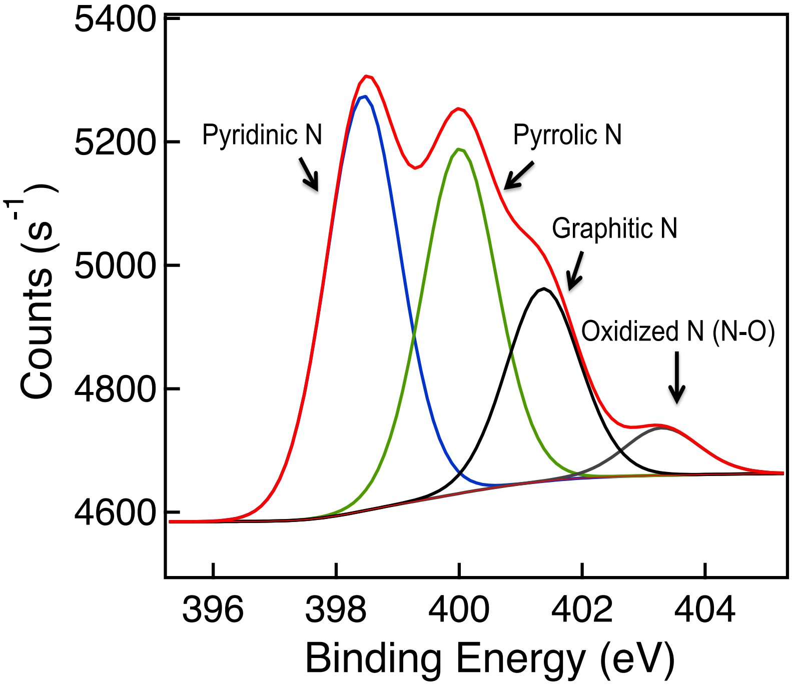

Figure S6. High resolution N1*s* XPS spectra of NG1.

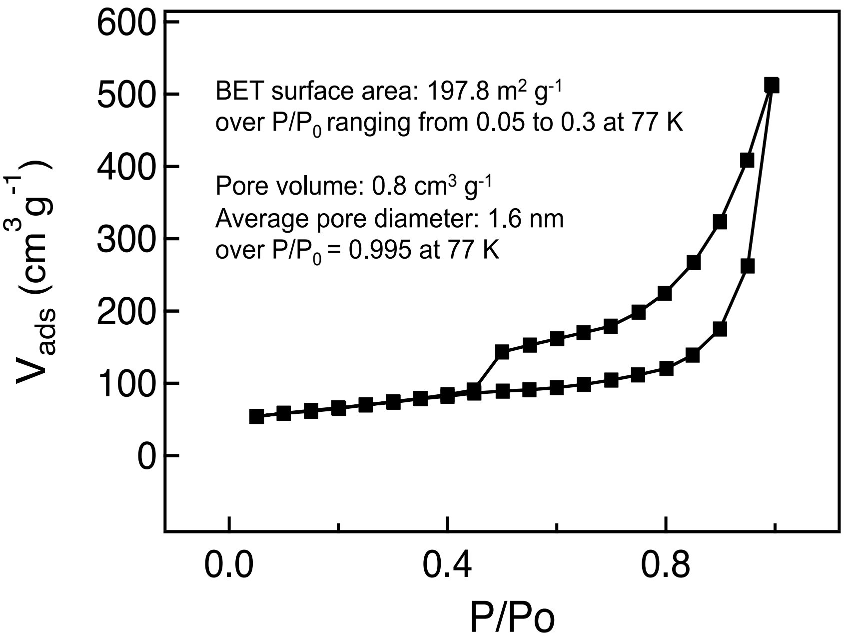

Figure S7. Nitrogen adsorption/desorption isotherm of NG10.

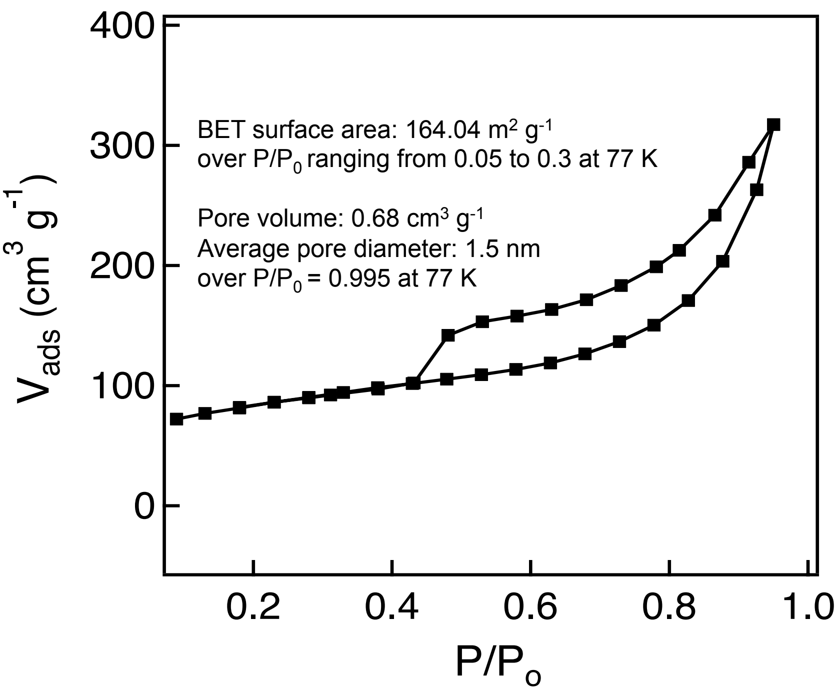

Figure S8. Nitrogen adsorption/desorption isotherm of NG5.

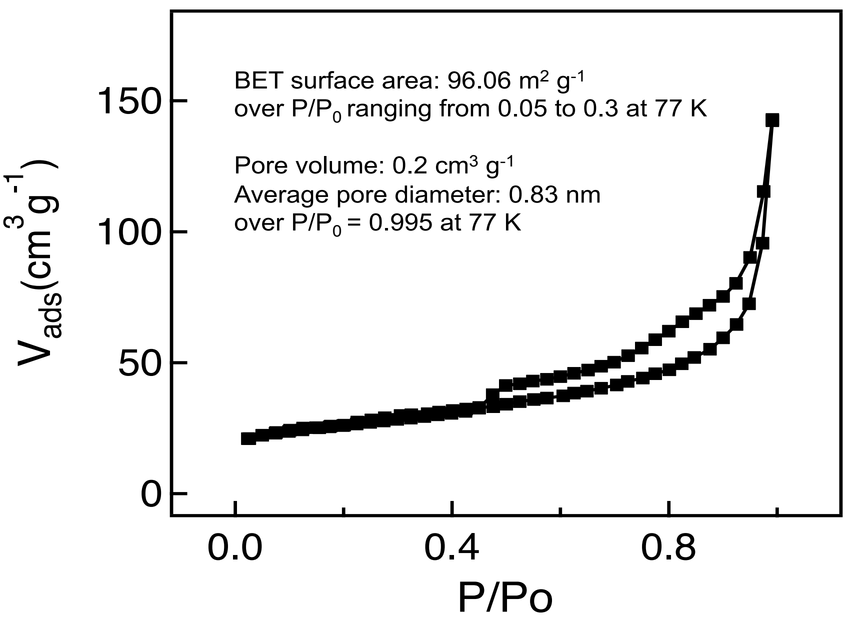

Figure S9 Nitrogen adsorption/desorption isotherms of NG1.

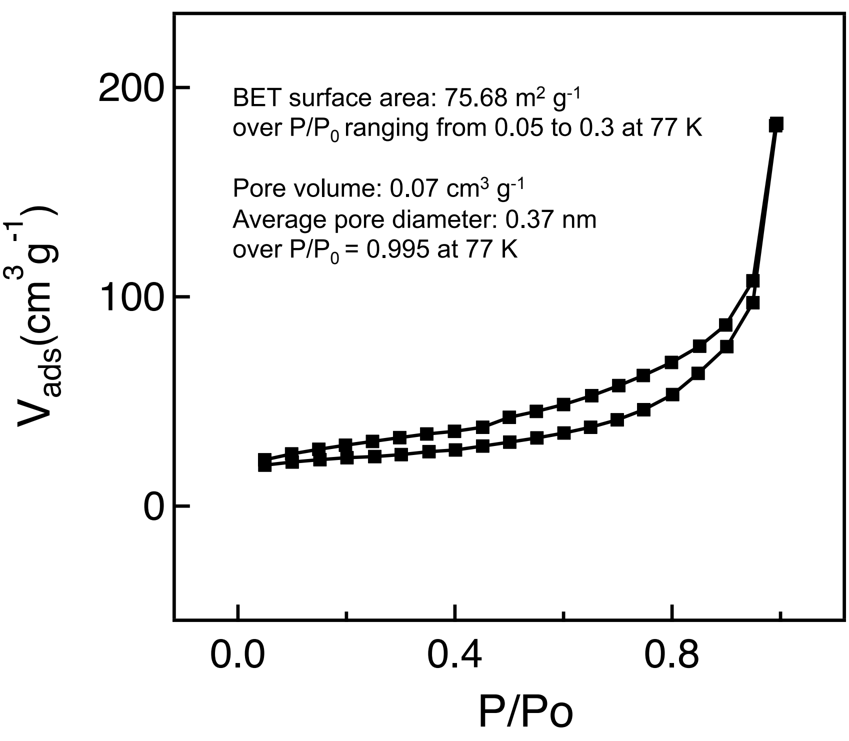

Figure S10. Nitrogen adsorption/desorption isotherm of rGO.

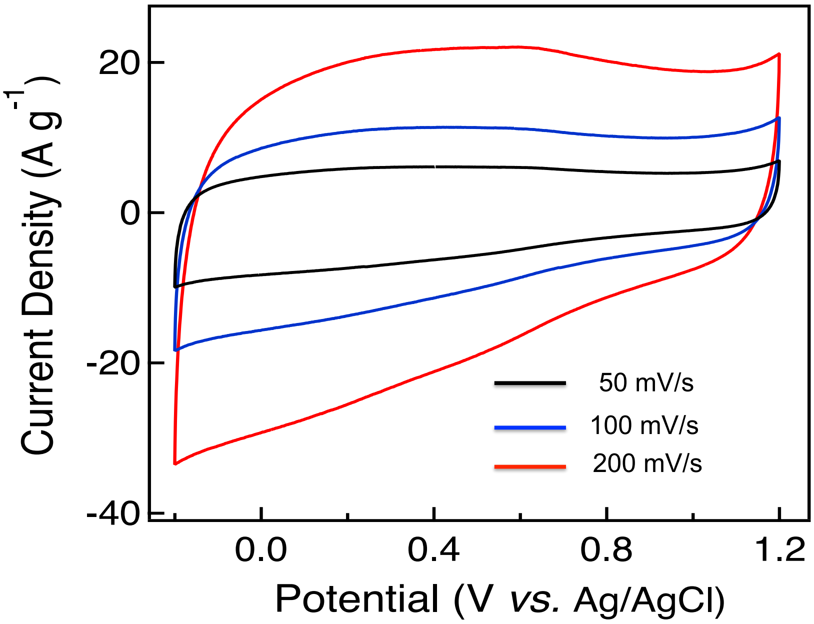

Figure S11. Cyclic voltammograms of NG10 in a three-electrode cell using Ag/AgCl as a reference electrode and Pt wire as counter electrode at scan rates of 50, 100 and 200 mV s^{-1} in 0.5-M H_2SO_4 solution.

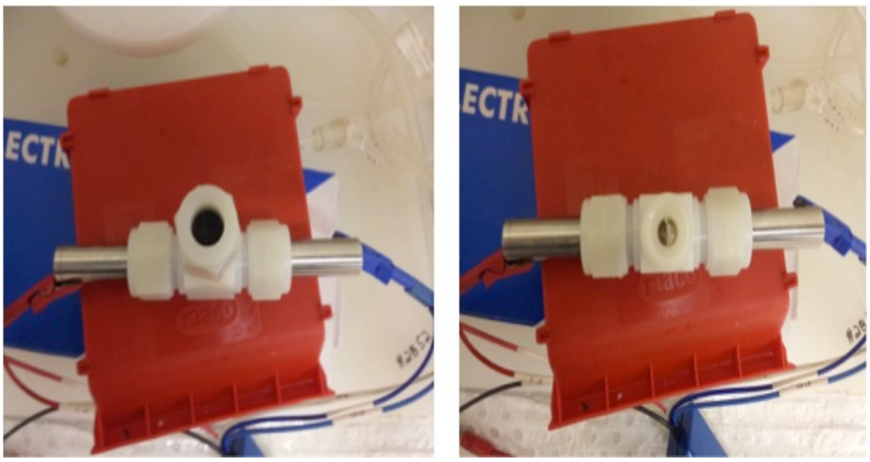

Figure S12. Optical images of stacked electrodes supercapacitor (T-cell).

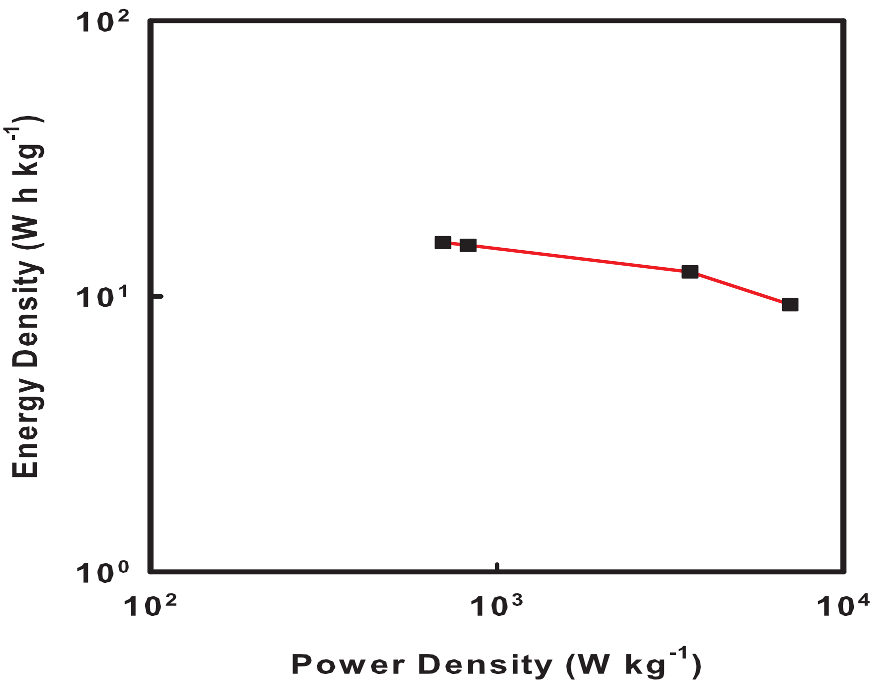

Figure S13. Ragone plot of the T-cell device based on two-electrode mass of active materials.

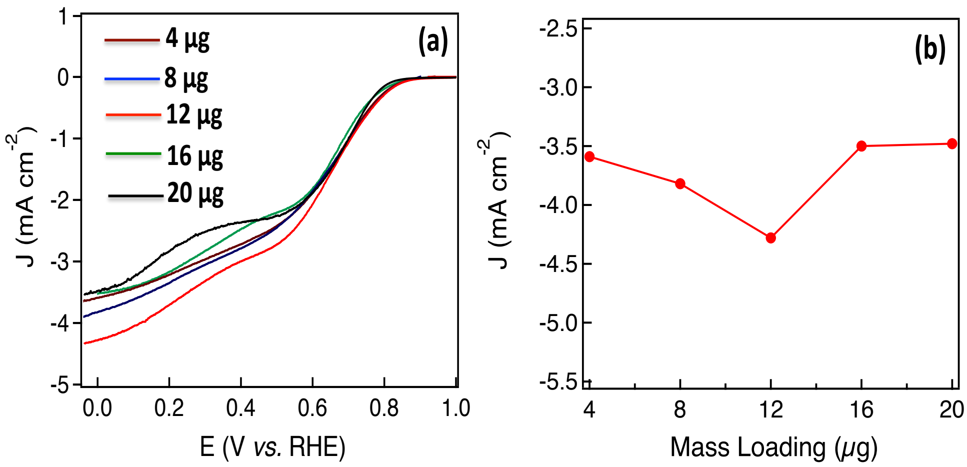

Figure S14. (a) LSV curves at 1600 rpm with the presence of oxygen for different mass loading of NG10 for ORR. (b) Comparison of current density with mass loading of active material.

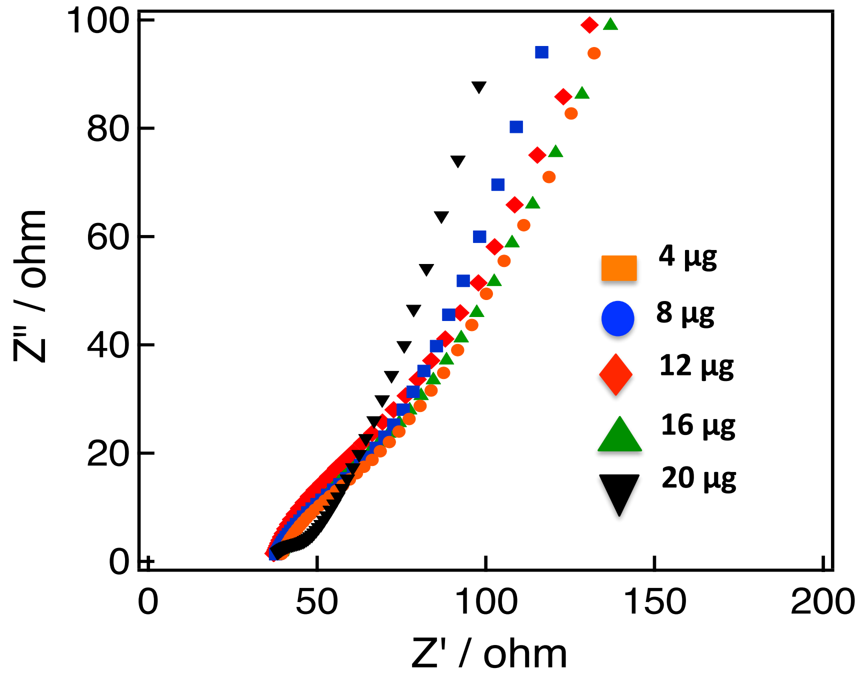

Figure S15. EIS curves for different mass loading of NG10.

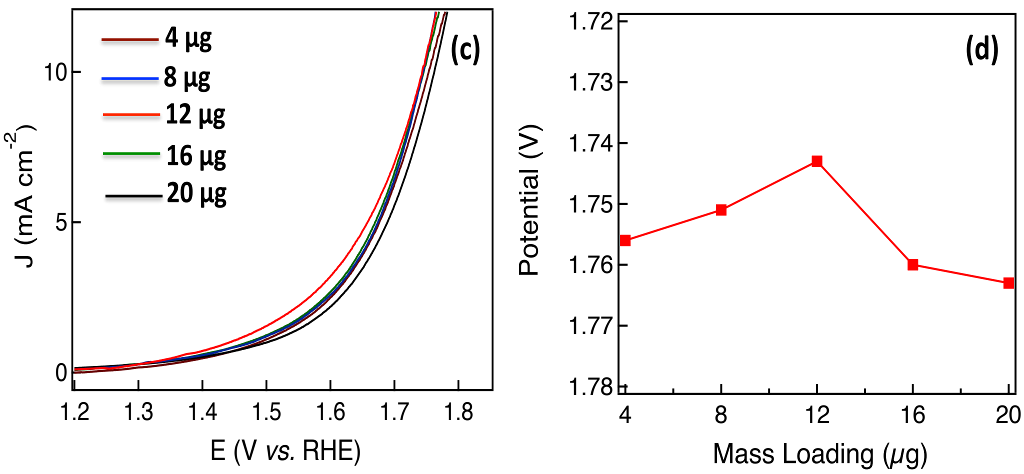

Figure S16. (a) LSV curves for different mass loading of NG10 for OER. (b) Comparison of Potentials at a current density of 10 mA cm^{-2} with the different mass loadings of active material.

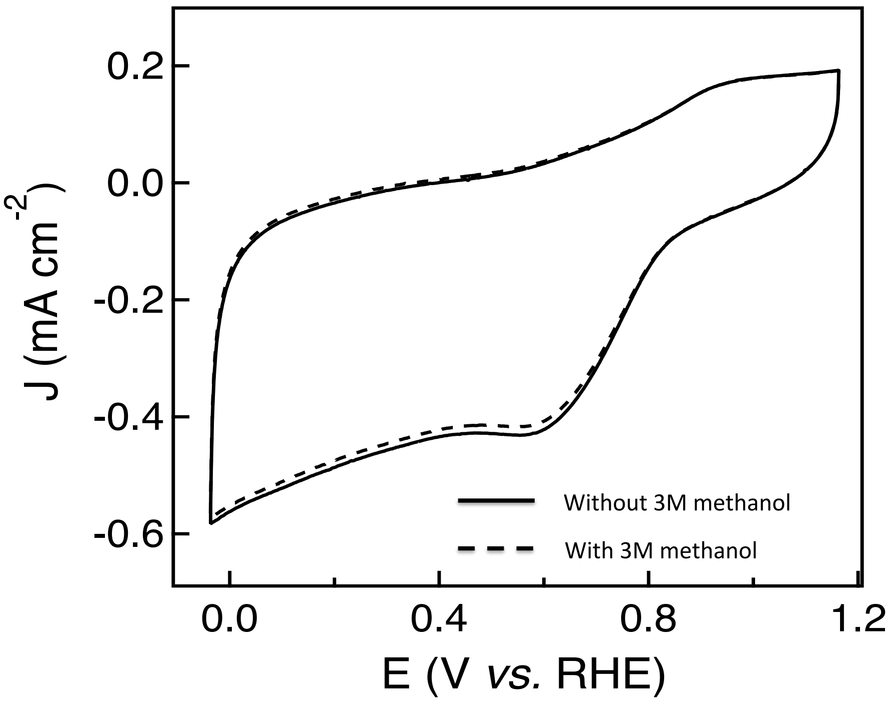

Figure S17. Cyclic voltammograms of NG10 at a scan rate of 50 mV s^{-1} in O_2-saturated 0.1-M KOH solution and O_2-saturated 0.1-M KOH solution containing 3 M methanol.

Table S1. Comparison of the gravimetric performance for the as-prepared NG10 with previously reported nitorgen-doped and boron-doped nanocarbon materials.

Material	Doping/ Reducing agent	Gravimetric Capacitance, C_g (F g^{-1})	Electrolyte	Energy density (Wh kg^{-1})	Ref.
Crumpled Nitrogen-doped Graphene nanosheets	Cyanamide (NH_2CN)	245.9 F g^{-1} at 1 A g^{-1}	$[Bu_4N]BF_4$ acetonitrile	-	1
3D Nitrogen-doped Graphene-CNT	Pyrrole	180 F g^{-1} at 0.5 A g^{-1}	6 M KOH	-	2
Reduced Graphene Oxide	Urea	255 Fg^{-1} at 0.5 Ag^{-1}	6 M KOH	-	3
Nitrogen-doped Graphene	Urea	326 F g^{-1} at 0.2 A g^{-1}	6 M KOH	25.02	4
3D Nitrogen and Boron co-doped Graphene	Ammonia boron triflouride (NH_3BF_3)	239 F g^{-1} at 1 mV s^{-1}	1 M H_2SO_4	8.7	5
Boron-doped graphene nanoplatelets	Borane-tetrahydrofuran (BH_3-THF)	160 F g^{-1} at 1 A g^{-1}	6 M KOH	-	6

Nitrogen-doped Graphene	phenylenediamine	301 F g^{-1} at 0.1 A g^{-1}	6 M KOH	-	7
Nitrogen-enriched nonporous carbon	Ammonia	198 F g^{-1} at 0.05 A g^{-1}	6 M KOH	-	8
Nitrogen-enriched carbon nanotube	Melamine	167 F g^{-1} at 1 V s^{-1}	1 M H_2SO_4	-	9
Nitrogen-doped porous carbon nanofiber	Polypyrrole	202 F g^{-1} at 1 A g^{-1}	6 M KOH	7.1	10
Nitrogen-doped porous carbon	Pyrrole	240 F g^{-1} at 0.1 A g^{-1}	1 M H_2SO_4	19.5	11
Nitrogen-doped carbon foam	Melamine	203 F g^{-1} at 0.5 A g^{-1}	6 M KOH	47.8	12
Graphitic Carbon nitride	Melamine	264 at F g^{-1} 0.4 A g^{-1}	0.1 M $LiClO_4$	30	13
Nitrogen-doped Graphene	Hexamethylenetetramine	270 F g^{-1} at 1 A g^{-1}	1 M H_2SO_4	-	14
Nitrogen-doped Graphene	Aminoterphthalic acid	210 F g^{-1} at 1 A g^{-1}	0.5 M H_2SO_4	-	15
Nitrogen-doped Graphene	**Uric Acid**	**230 Fg^{-1} at 1 A g^{-1}**	**0.5 M H_2SO_4**	**62.6**	**This work**

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