Supplementary material

One-pot synthesis of B-doped three dimensional reduced graphene oxide *via* supercritical fluid for oxygen reduction reaction

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The number of transferred electrons (n) per O_2 molecule in the ORR and kinetic current density can be calculated from the Koutecky-Levich equation shown as follows,[1]

$$\frac{1}{J} = \frac{1}{J_L} + \frac{1}{J_K} = \frac{1}{B\omega^{1/2}} + \frac{1}{J_K} \quad (1)$$

$$B = 0.62nFC_0(D_0)^{2/3}v^{-1/6} \quad (2)$$

where J is the measured current density, J_K and J_L are the kinetic- and diffusion-limiting current densities, respectively, ω is the angular velocity of the disk ($\omega=2\pi N$, N is the linear rotation speed), n is the overall number of electrons transferred in ORR, F is the Faraday constant (F=96485 C mol^{-1}), C_0 is the bulk concentration of O_2 (C_0=1.2×10^{-6} mol cm^{-3}), D_0 is the diffusion coefficient of O_2 in 0.1 M KOH (D_0=1.9×10^{-5} cm^2 s^{-1}), and v is the kinematic viscosity of the electrolyte (v =0.01 cm^2 s^{-1}). The constant of 0.2 is adopted when the rotation rate is expressed in rpm.[1,2]

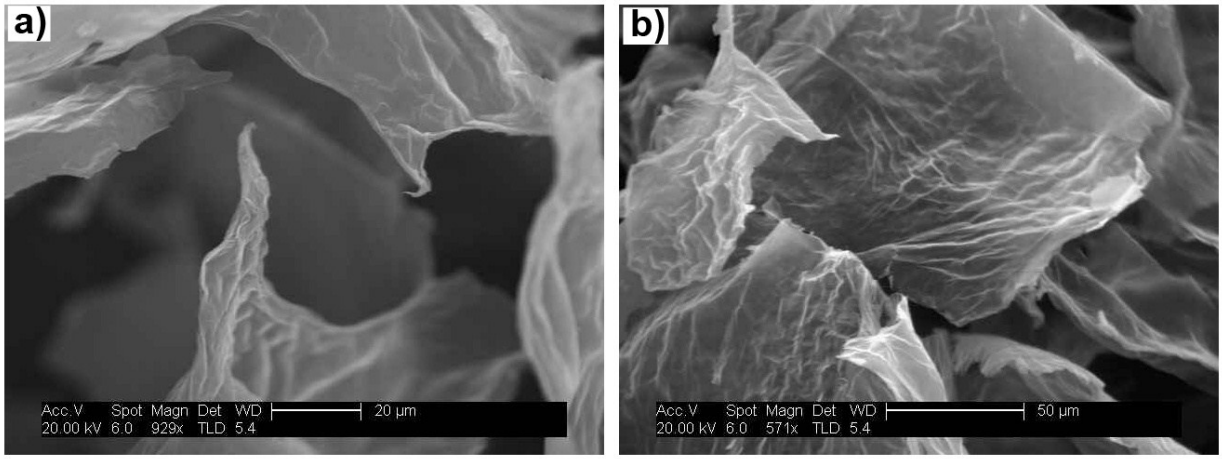

Fig. S1. SEM images showing morphology of sample fabricated under the same preparation conditions but of from different initial GO concentration at (a) 5 mg mL^{-1} and (b) 15 mg mL^{-1}.

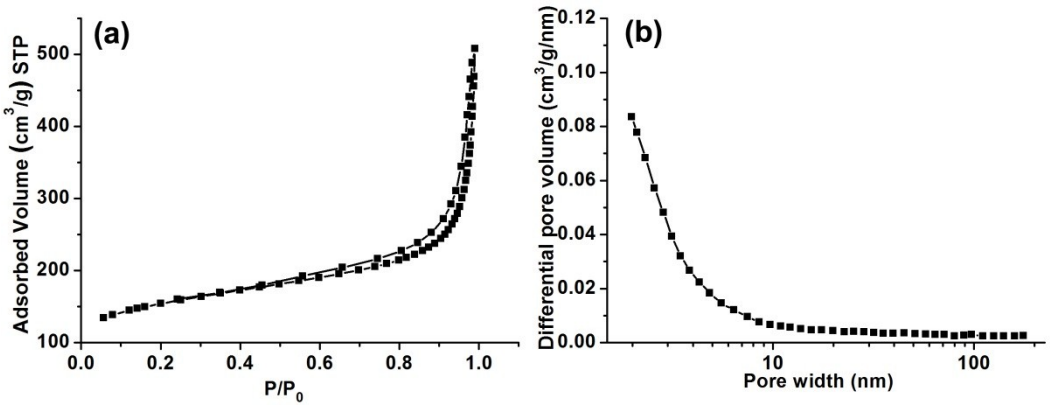

Fig. S2 (a) Nitrogen adsorption/desorption isotherms and (b) pore size distribution in B1-3DrGO.

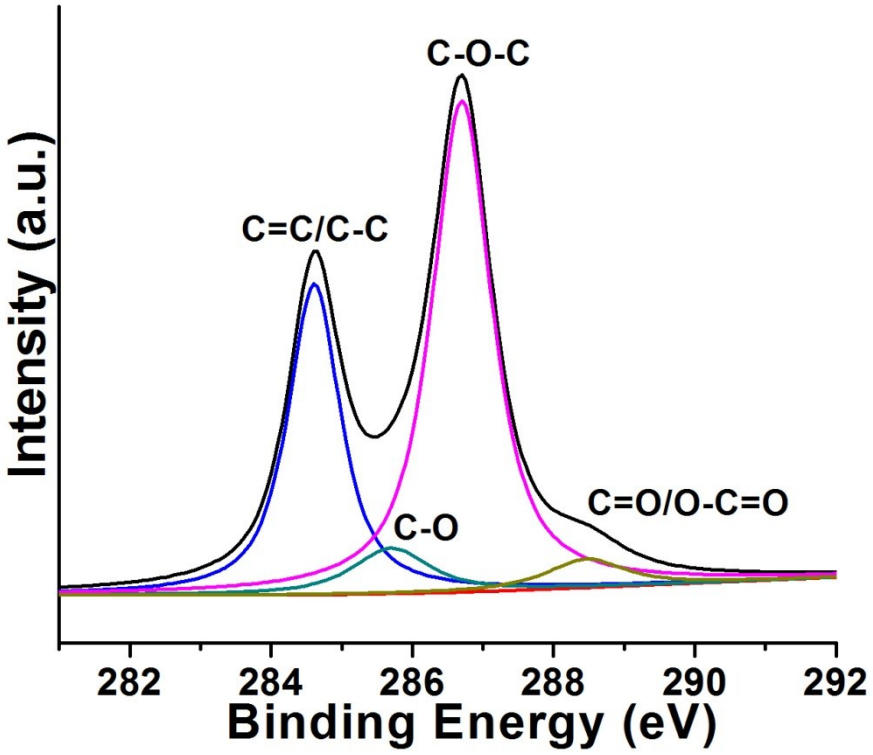

Fig. 3. XPS C 1s spectrum of GO sheets.

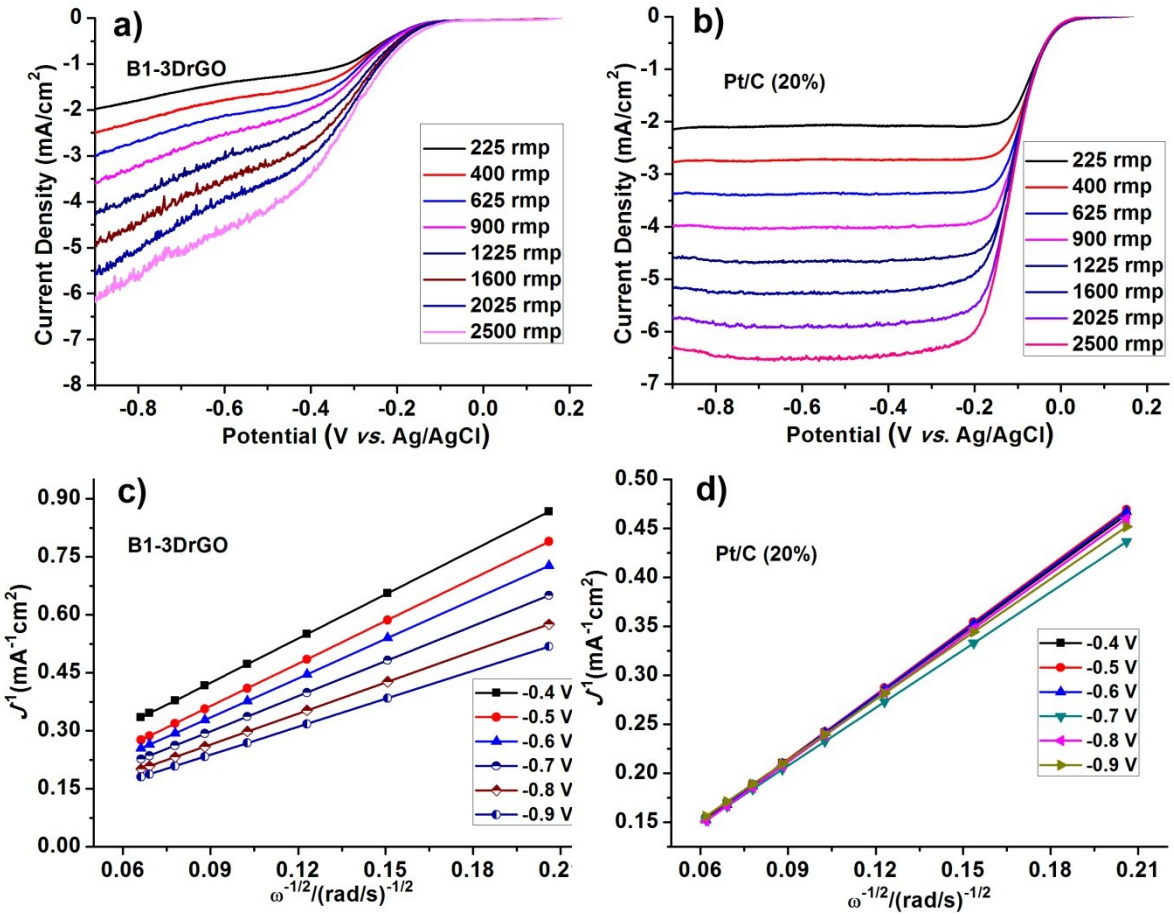

Fig. S4. ORR polarization curves of (a) B1-3DrGO and (b) commercial Pt/C (20 wt. %) in O_2- saturated 0.1 M KOH solution with various rotation rates at a scan rate of 10 mV s^{-1}. Koutecky–Levich (K-L) plots of (c) B1-3DrGO and (d) commercial Pt/C (20 wt. %) at different electrode potentials. The experimental data were obtained from (a) and (b), respectively.

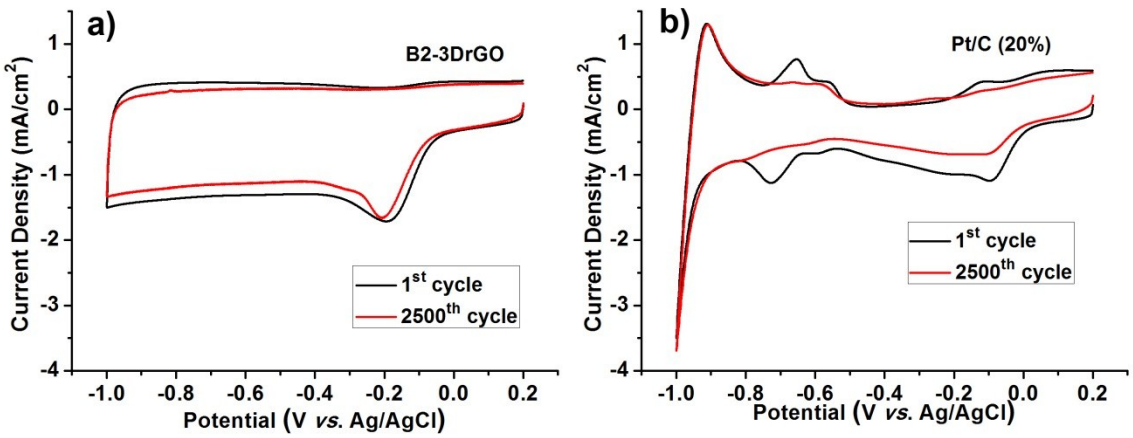

Fig. S5. Cyclic voltammograms of (a) B2-3DrGO and (b) commercial Pt/C (20 wt. %) before and after 2500 cycles in O_2-saturated 0.1 M KOH solution at a scan rate of 10 mV s^{-1} and a rotating rate of 200 rpm.

Table S1. The C 1s peak position, the relative atomic percentage of various functional groups and B content in GO sheets, B1-3DrGO and B2-3DrGO products.

Sample	C 1s fitting Binding energy (eV)(relative area percentage)				C/O ratio	B content (atomic ratio)
	C=C/C-C	C-O	C-O-C	C=O/O-C=O		
GO	284.7 (31.56 %)	285.7 (6.96 %)	286.7 (56.96 %)	288.5 (4.43%)	1.31	/
B1-3DrGO	284.6 (51.15 %)	285.5 (23.07 %)	286.7 (19.87 %)	287.8 (5.91%)	4.5	2.1 %
B2-3DrGO	284.5 (68.94 %)	285.7 (18.41 %)	/	288.8 (12.65%)	5.9	2.9 %

Reference

(1) Li, Y.; Cheng, H. H.; Hu, Y.; Shi, G. Q.; Dai, L. M.; Qu, L. T. *J. Am. Chem. Soc.* **2012**, *134*, 15-18.

(2) Sharifi, T.; Hu, G.; Jia, X. E.; Wagberg, T. *ACS Nano* **2012**, *6*, 8904-8912.