Electronic Supplementary Information for

Electrostatically regulated ternary-doped carbon foams with exposed active sites as metal-free oxygen reduction electrocatalysts

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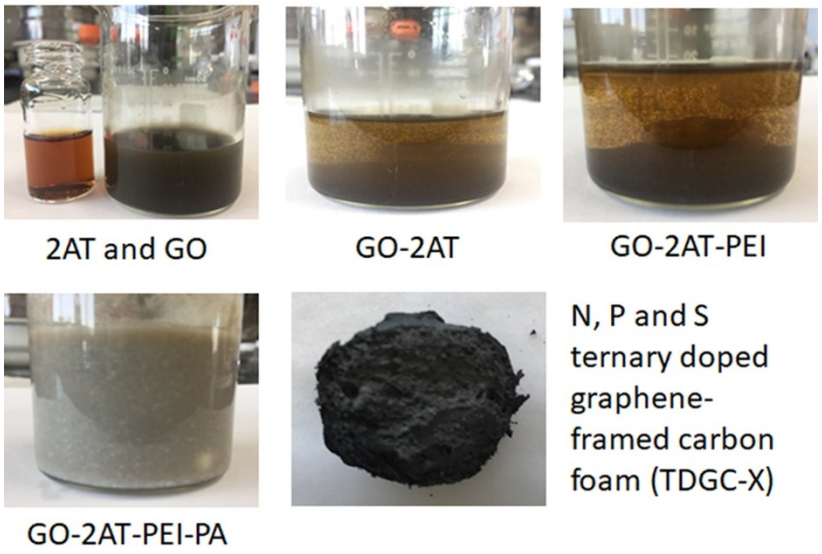

Fig. S1 Digital images of GO and 2AT and the intermediates obtained after the addition of different precursors. It also shows the pyrolysed product.

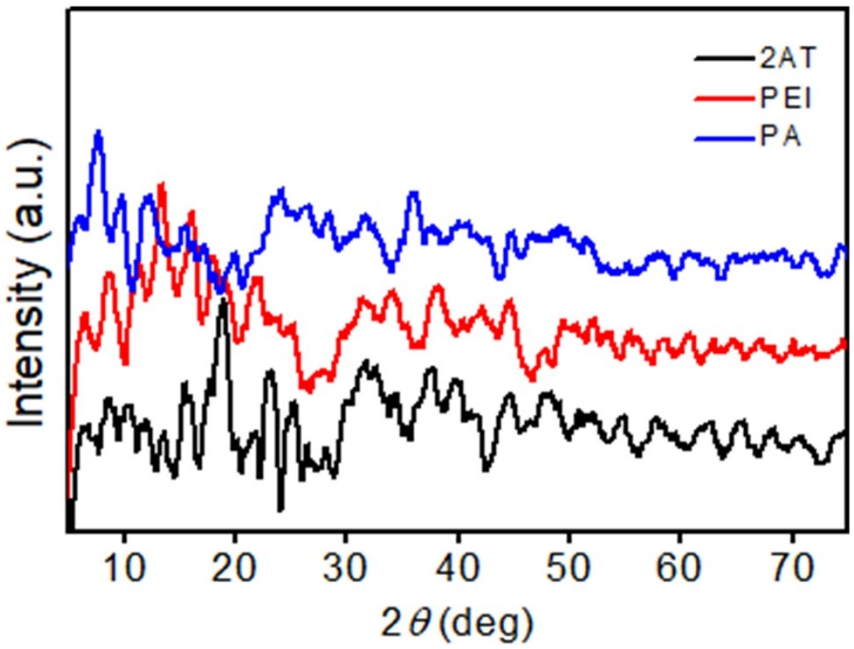

Fig. S2 XRD patterns of 2AT, PEI, and PA

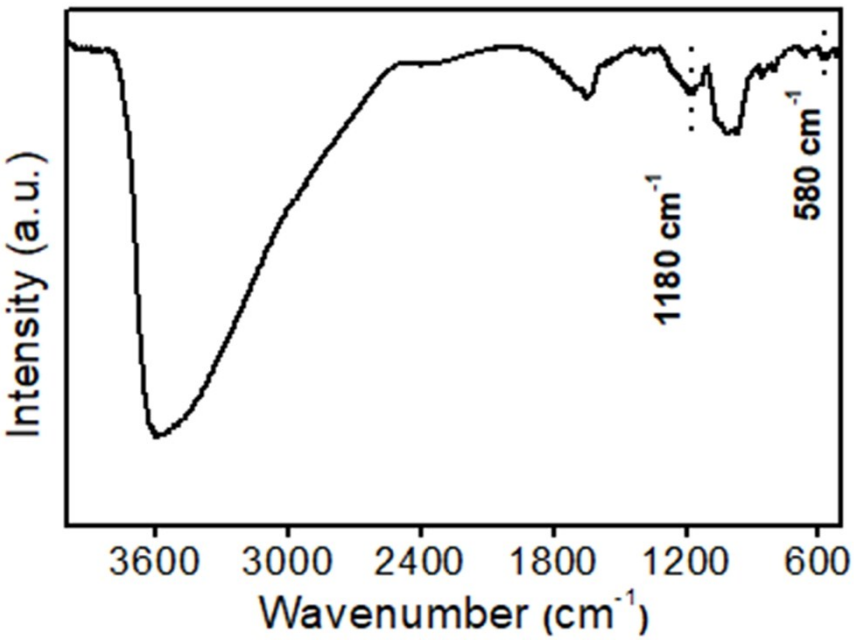

Fig. S3 FT-IR of phytic acid (PA).

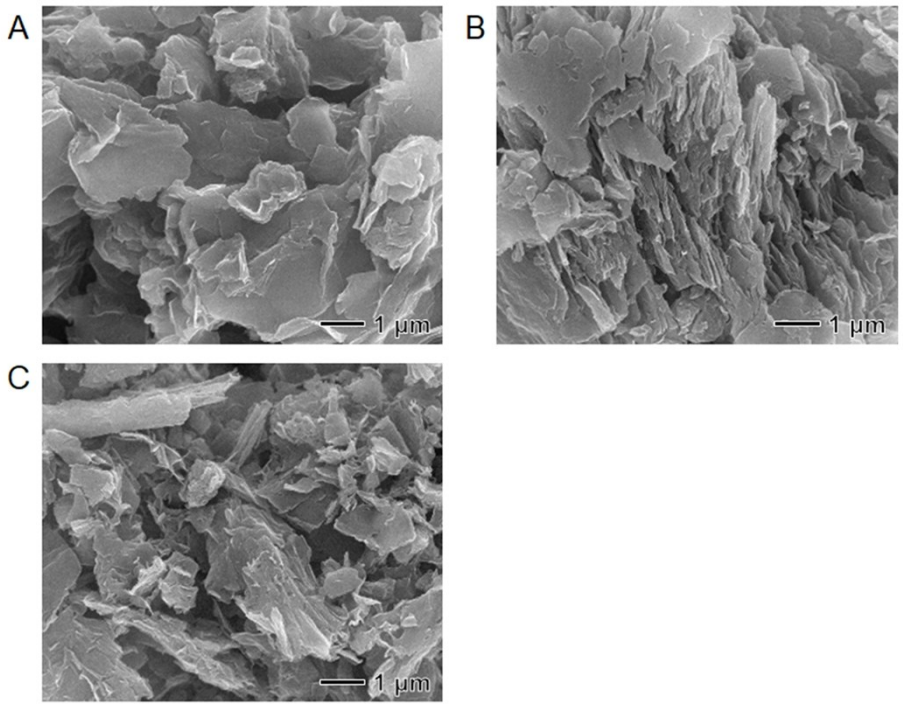

Fig. S4 SEM images of (A) GO, (B) GO-2AT, and (C) GO-2AT-PEI.

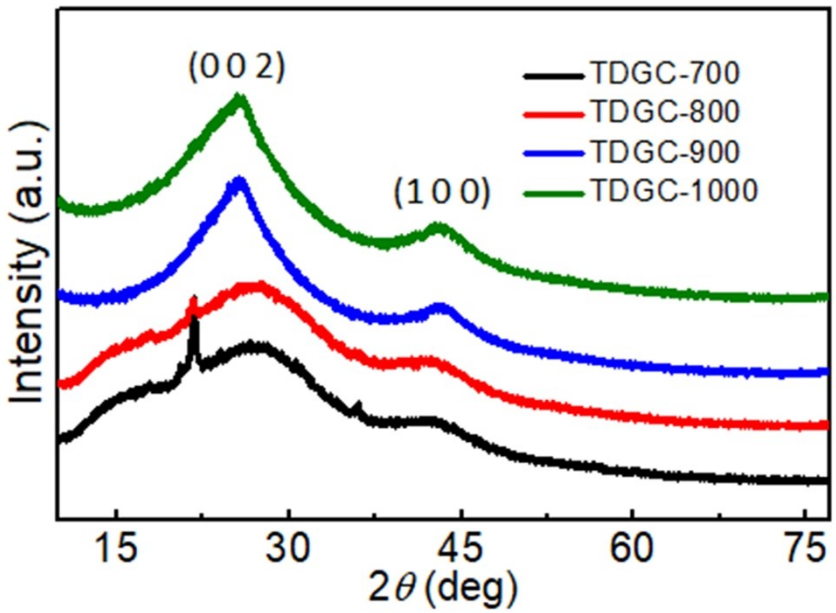

Fig. S5 XRD patterns of TDGC-700, TDGC-800, TDGC-900, and TDGC-1000.

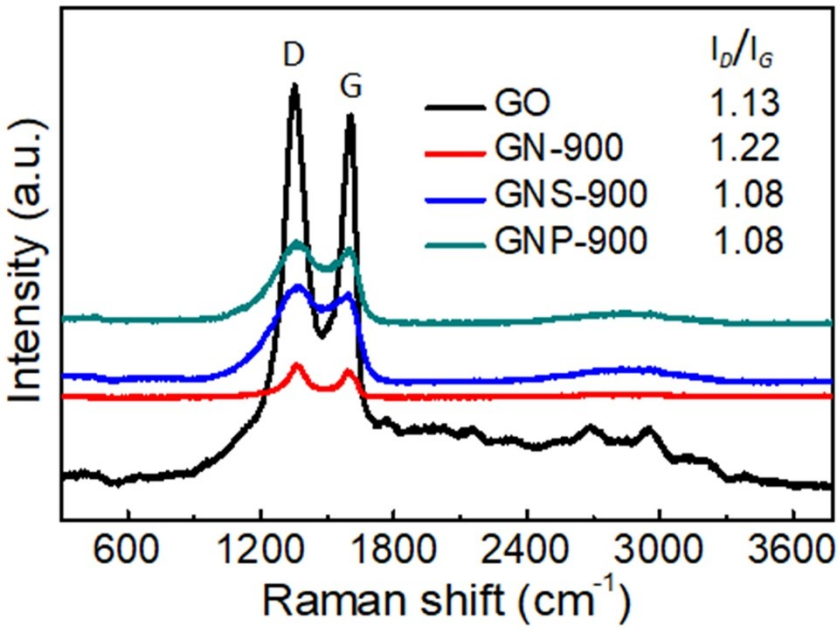

Fig. S6 Raman spectra of GO, GN-900, GNS-900 and GNP-900.

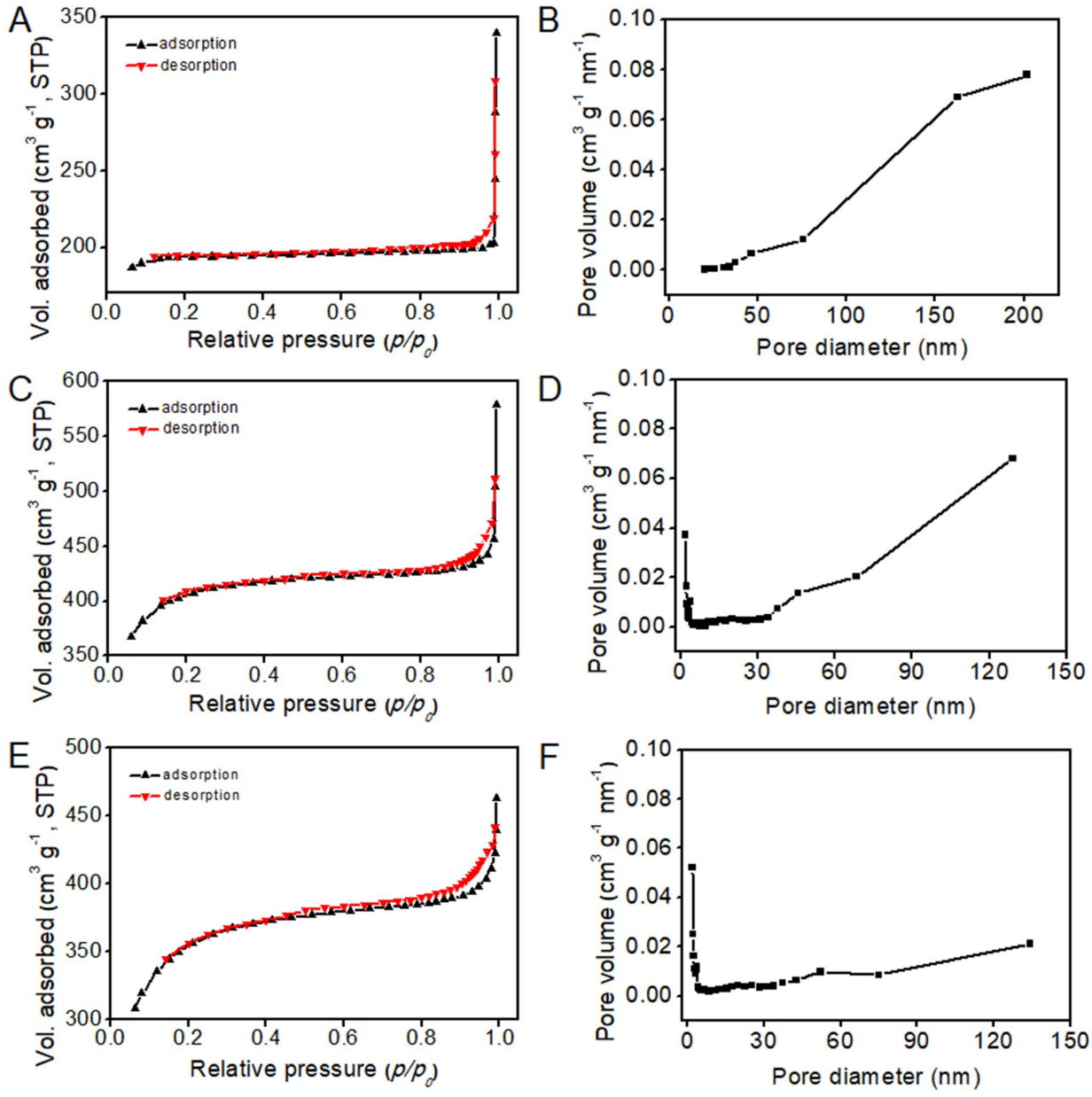

Fig. S7 Nitrogen adsorption-desorption isotherms and pore size distribution of (A, B) TDGC-700, (C, D) TDGC-800, and (E, F) TDGC-1000.

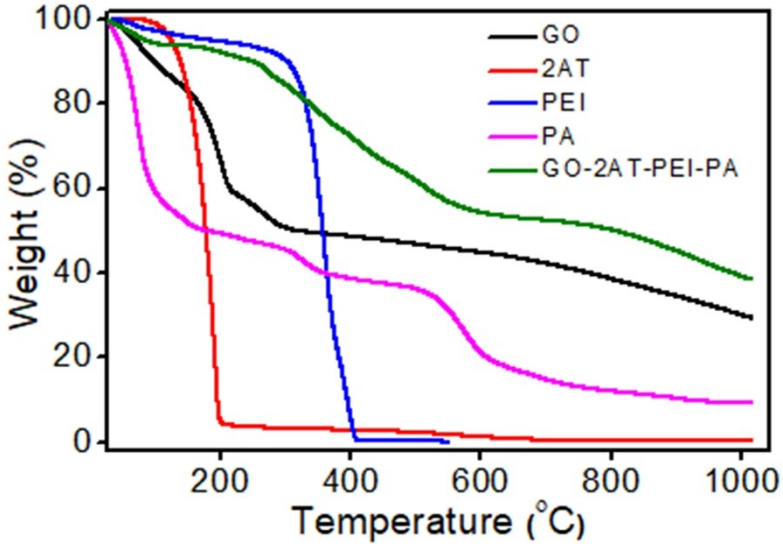

Fig. S8 TGA traces of the GO, 2AT, PEI, PA, and GO-2AT-PEI-PA.

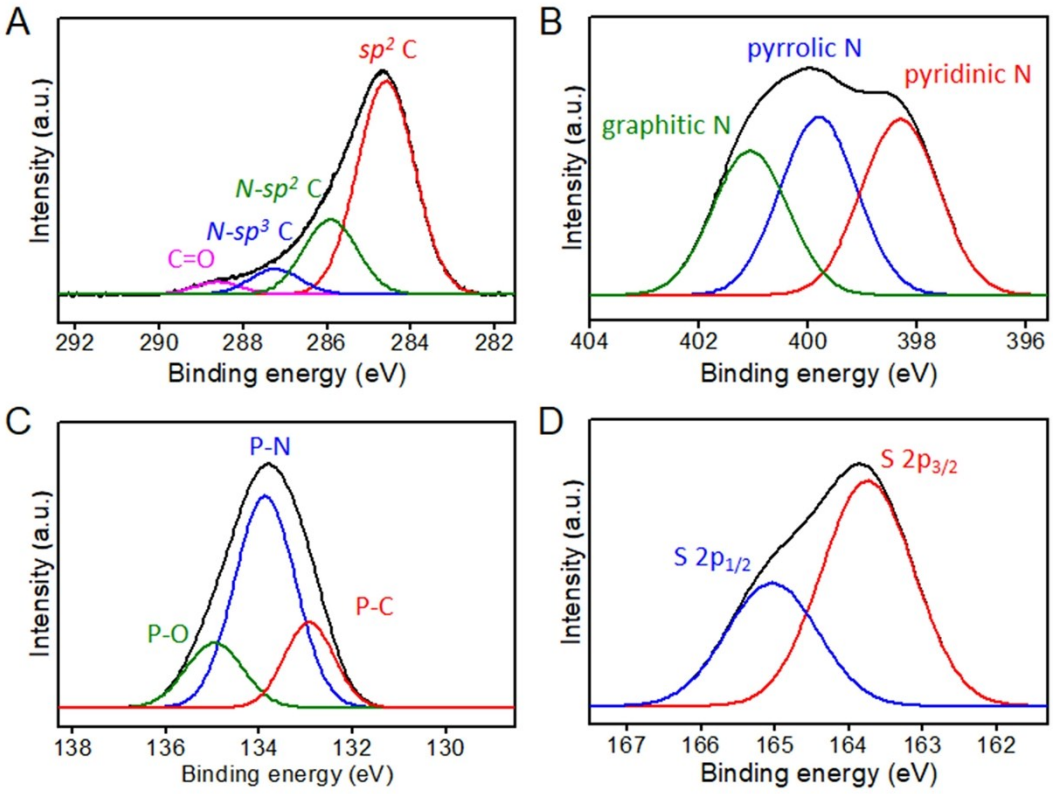

Fig. S9 (A) C XPS 1s core level spectrum, (B) N XPS 1s core level spectrum, (C) P XPS 2p core level spectrum, and (D) S XPS 2p core level spectrum of TDGC-700.

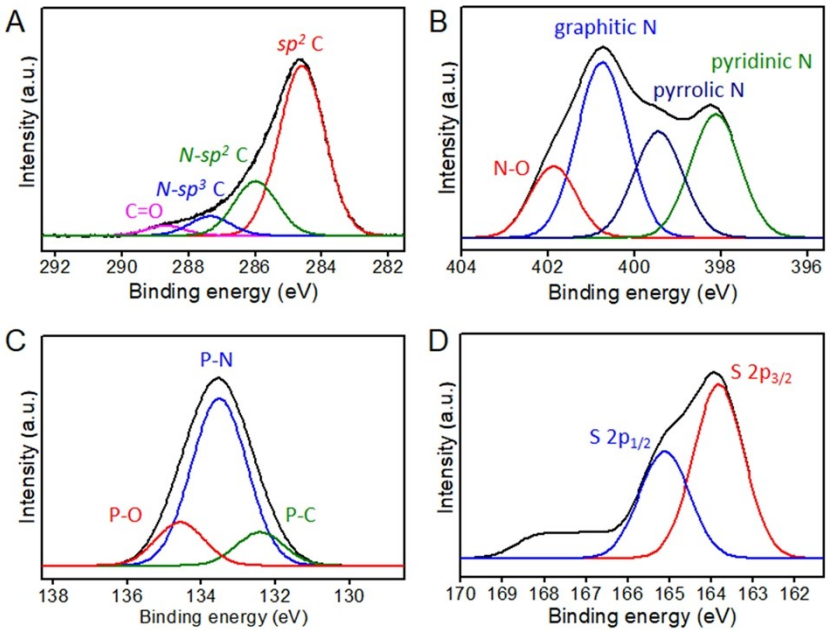

Fig. S10 (A) C XPS 1s core level spectrum, (B) N XPS 1s core level spectrum, (C) P XPS 2p core level spectrum, and (D) S XPS 2p core level spectrum of TDGC-800.

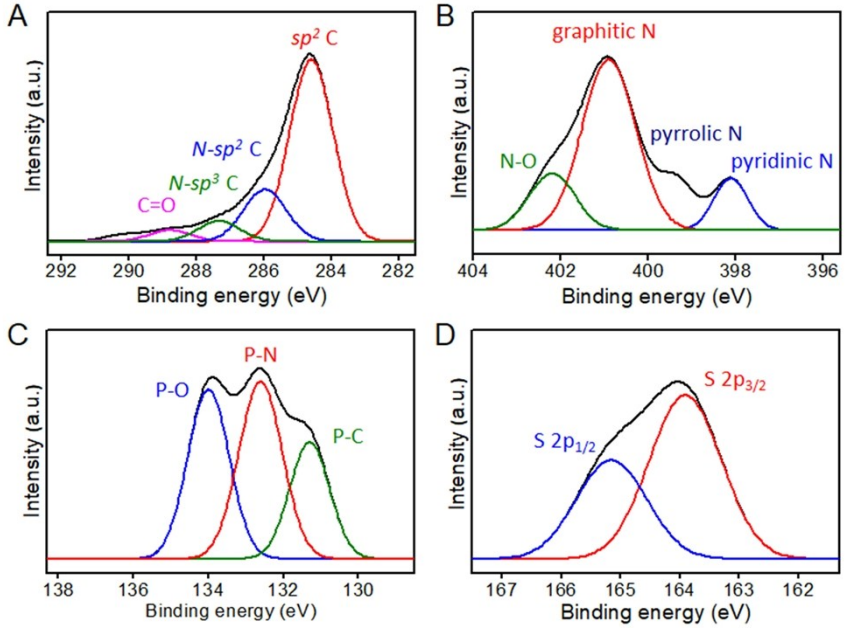

Fig. S11 (A) C XPS 1s core level spectrum, (B) N XPS 1s core level spectrum, (C) P XPS 2p core level spectrum, and (D) S XPS 2p core level spectrum of TDGC-1000.

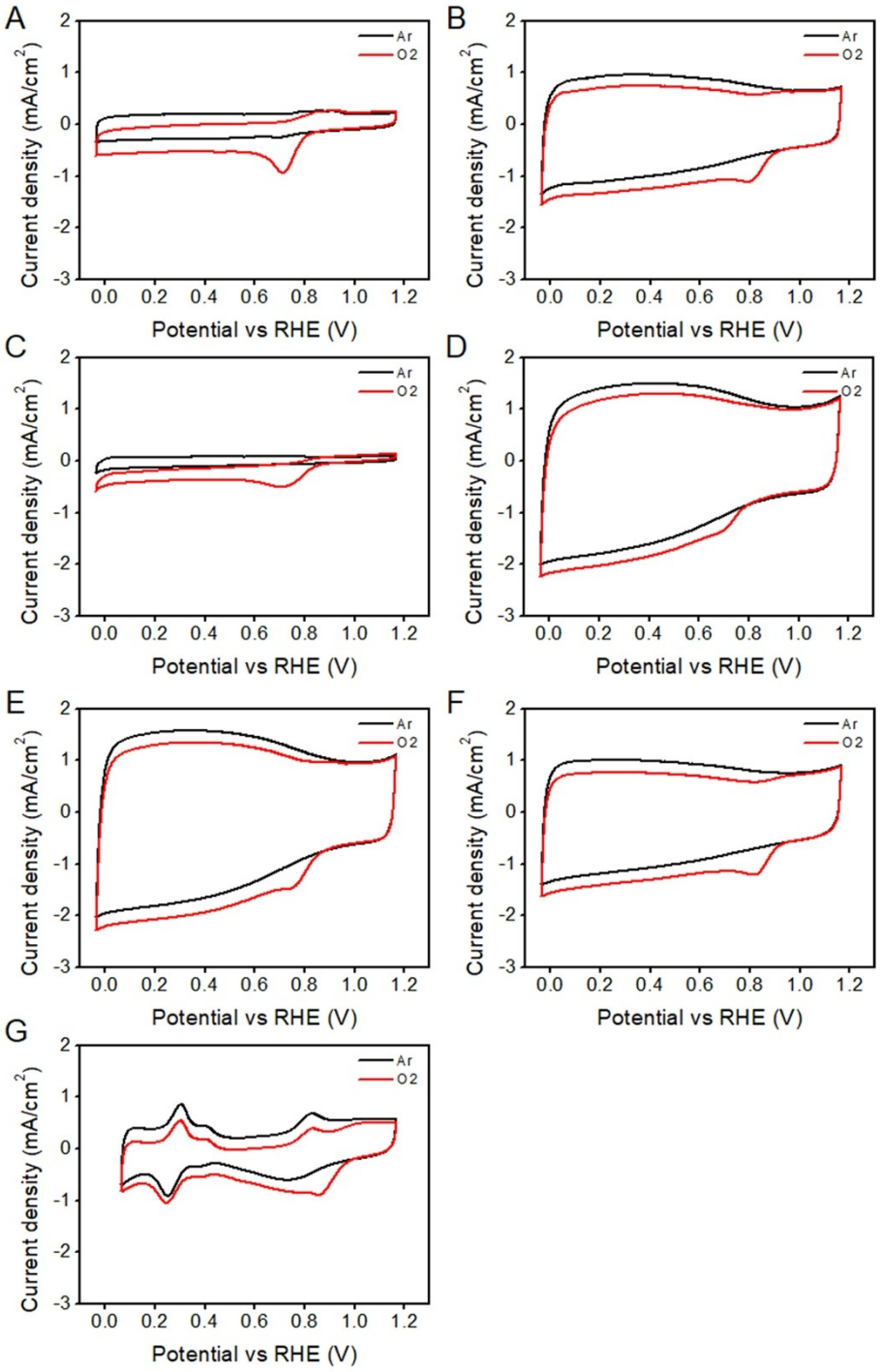

Fig. S12 CV curves of (A) GN-900, (B) GNP-900, (C) GNS-900, (D) TDGC-700, (E) TDGC-800, (F) TDGC-1000 and (G) commercial Pt/C in Ar and O_2 saturated 0.1 M KOH solution.

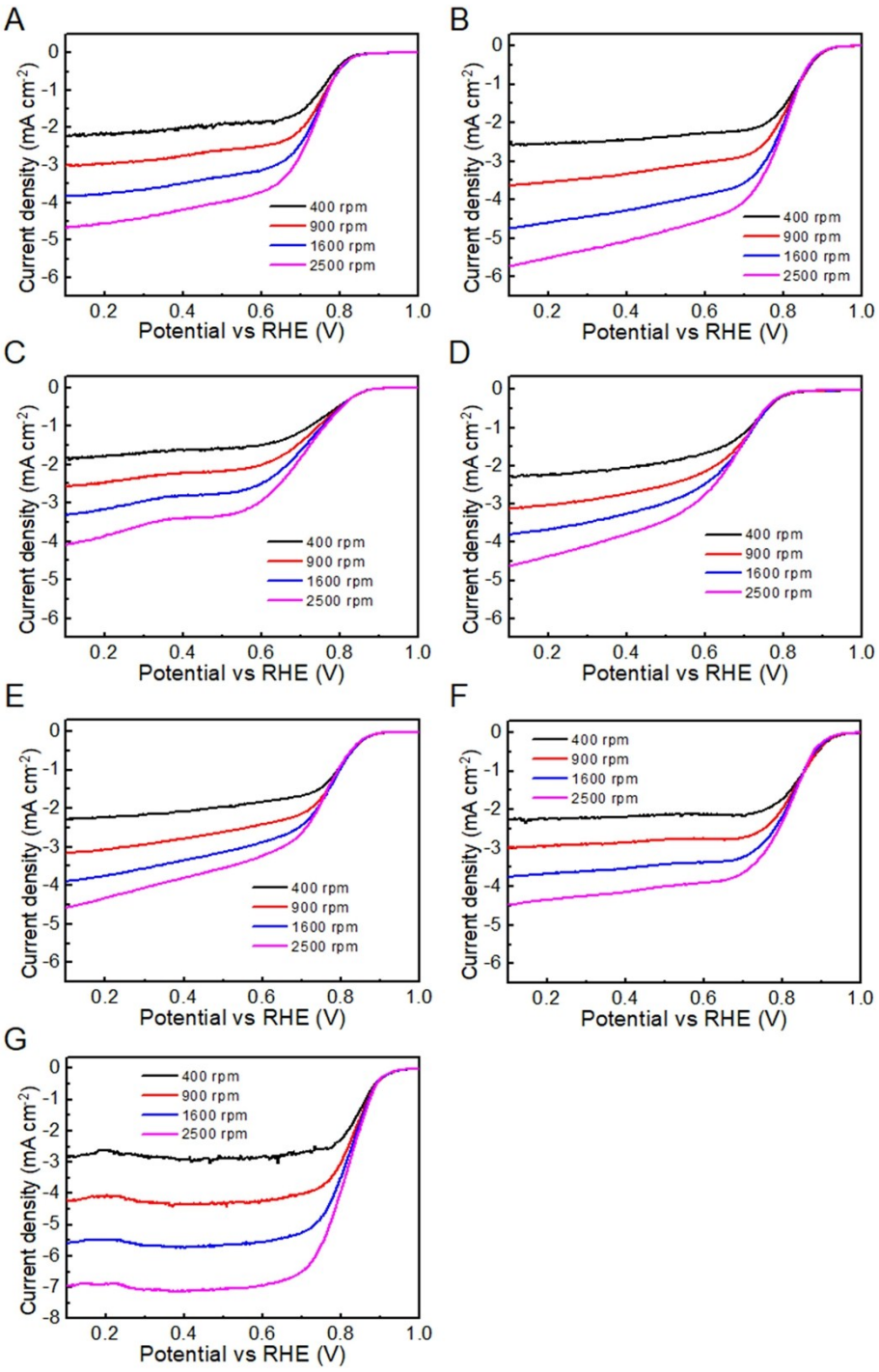

Fig. S13 LSV curves of (A) GN-900, (B) GNP-900, (C) GNS-900, (D) TDGC-700, (E) TDGC-800, (F) TDGC-1000 and (G) commercial Pt/C in O_2 saturated 0.1 M KOH at various rotating speeds.

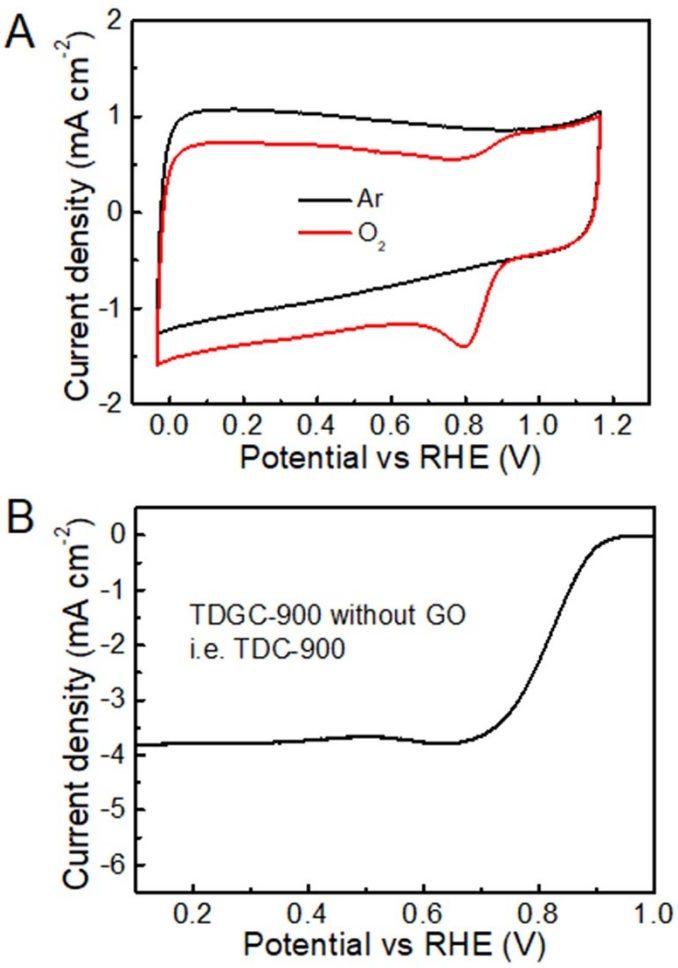

Fig. S14 (A) CV curves in Ar and O_2 saturated 0.1 M KOH solution and (B) LSV curve at an RDE (1,600 r.p.m.) in O_2-saturated 0.1 M KOH solution of TDGC-900 without GO.

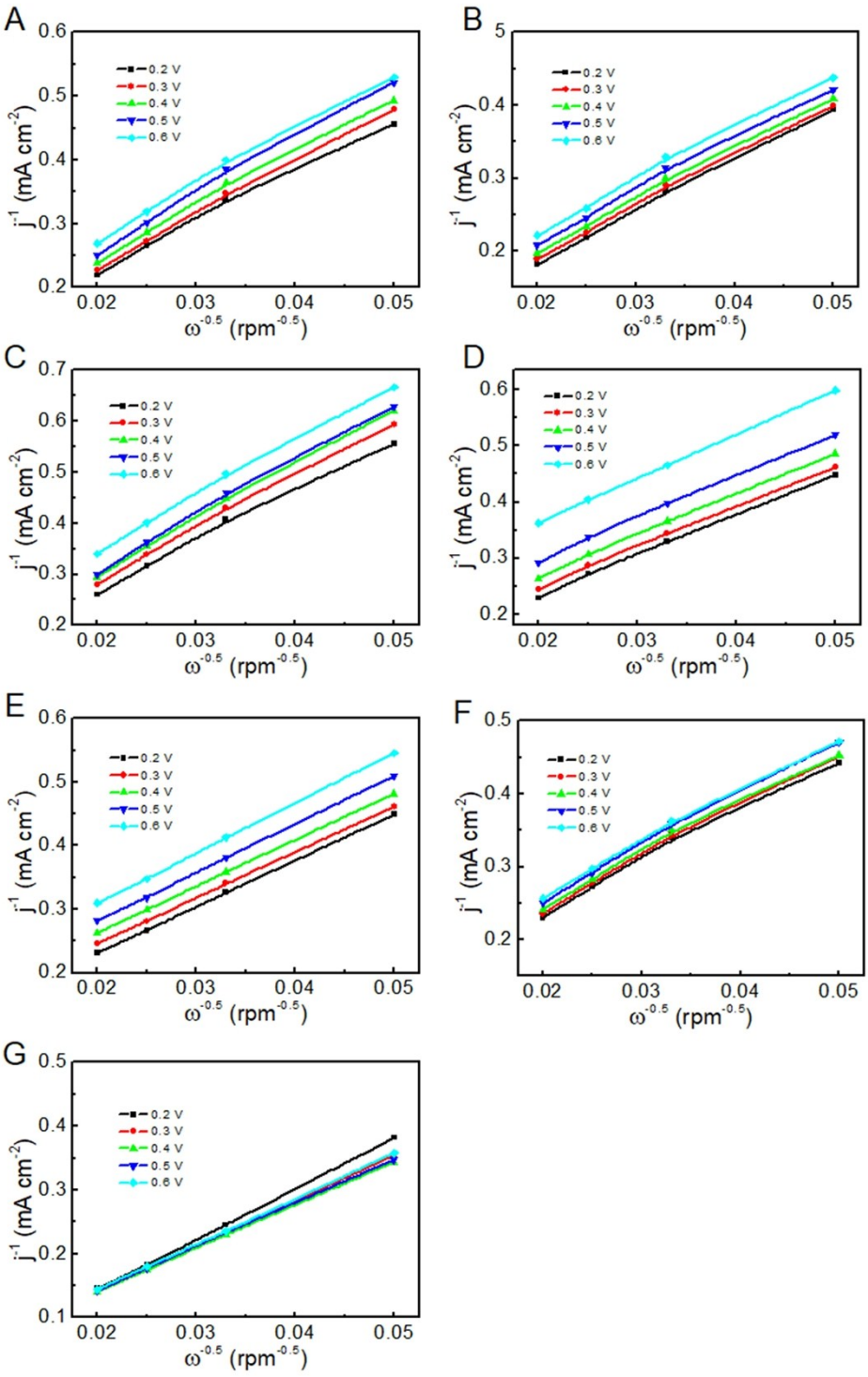

Fig. S15 K–L plots of (A) GN-900, (B) GNP-900, (C) GNS-900, (D) TDGC-700, (E) TDGC-800, (F) TDGC-1000 and (G) commercial Pt/C at various potentials.

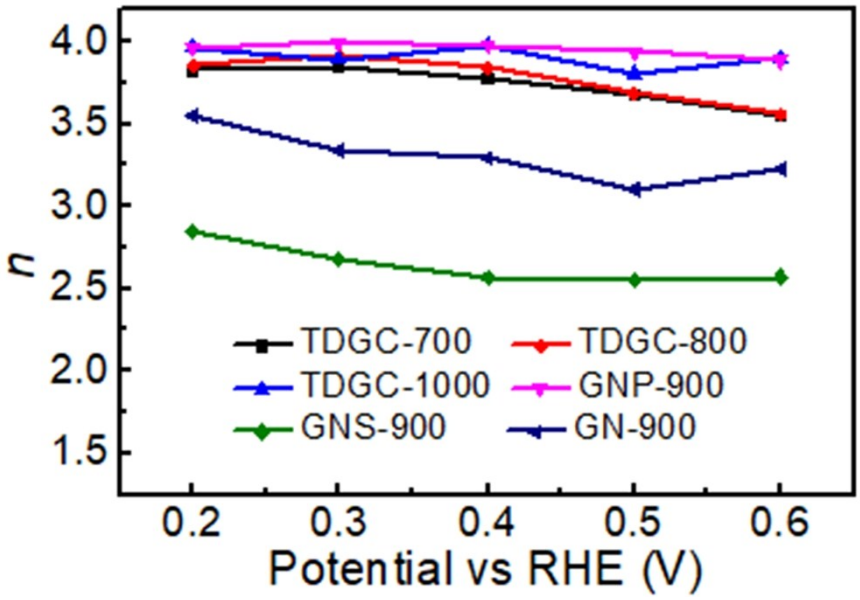

Fig. S16 Electron transfer number of TDGC-700, TDGC-800, TDGC-1000, GNP-900, GNS-900, and GN-900 at different potentials.

Table S1. BET specific surface area, pore diameter and pore volume of TDGC-700, TDGC-800, TDGC-900 and TDGC-1000.

Sample	BET specific surface area ($m^2 g^{-1}$)	Pore diameter (nm)	Pore volume ($cm^3 g^{-1}$)
TDGC-700	636	18, 50	0.31
TDGC-800	925	20, 51	0.71
TDGC-900	1107	5, 18, 118	0.87
TDGC-1000	1219	20, 55	0.65

Table S2. Oxygen reduction potential of GN-900, GNP-900, GNS-900, TDGC-700, TDGC-800, TDGC-900, TDGC-1000 and commercial Pt/C.

Sample	ORR potential (V vs. RHE)
GN-900	0.71
GNP-900	0.79
GNS-900	0.72
TDGC-700	0.71
TDGC-800	0.75
TDGC-900	0.82
TDGC-1000	0.80
Pt/C	0.85

Table S3. Quantification of different types of nitrogen in TDGC-700, TDGC-800, TDGC-900, and TDGC-1000.

Sample	Pyridinic N	Pyrrolic N	Graphitic N	N-oxide
TDGC-700	35.59	35.69	28.72	-
TDGC-800	23.30	21.71	40.37	14.62
TDGC-900	20.32	13.38	50.23	16.07
TDGC-1000	11.51	11.93	59.50	17.06

Table S4. Elemental composition of TDGC-700, TDGC-800, TDGC-900, and TDGC-1000.

Sample	C	O	N	P	S
TDGC-700	59.1	24.2	5.9	7.6	3.2
TDGC-800	75.2	16.0	3.1	3.6	2.1
TDGC-900	88.9	6.4	2.2	1.0	1.5
TDGC-1000	93.1	4.0	1.4	0.3	1.2

Table S5. Onset and half-wave potential of GN-900, GNP-900, GNS-900, TDGC-700, TDGC-800, TDGC-900, TDGC-1000 and commercial Pt/C.

Sample	Potential (V vs. RHE)	
	onset	half-wave
GN-900	0.87	0.75
GNP-900	0.94	0.81
GNS-900	0.89	0.72
TDGC-700	0.85	0.70
TDGC-800	0.90	0.77
TDGC-900	0.97	0.83
TDGC-1000	0.97	0.82
Pt/C	0.97	0.82