Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supporting Information

Boron, Nitrogen and Phosphorous Ternary Doped Graphene Aerogel with Hierarchically Porous Structures as Highly Efficient Electrocatalysts for Oxygen Reduction Reaction

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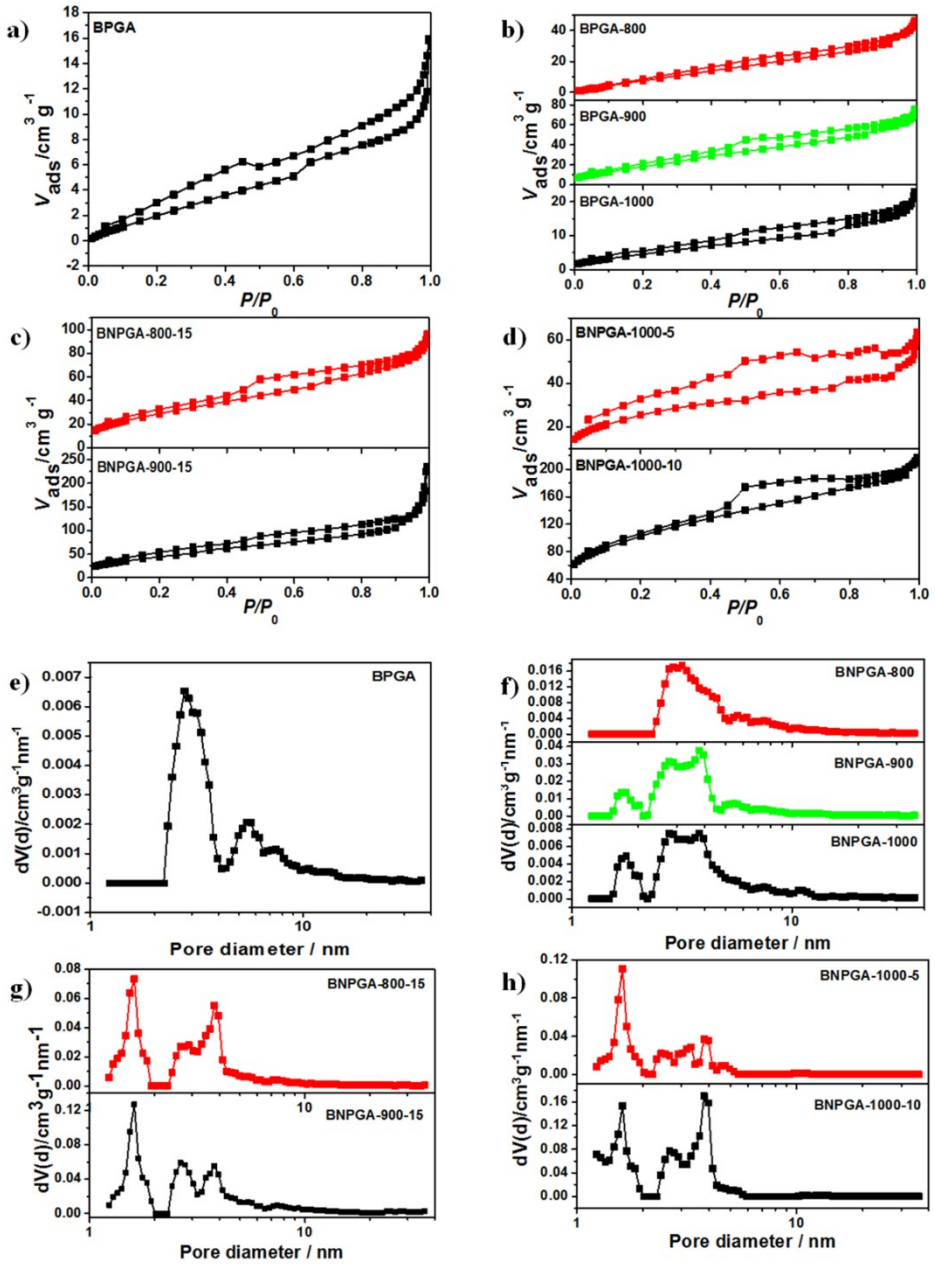

Fig. S1. Nitrogen adsorption-desorption isotherms **(a)**, **(c)**, **(e)**, **(g)** and pore size distributions **(b)**, **(d)**, **(f)**, **(h)** of BNPGA,BNPGA-X_1(X_1=800,900,1000), BNPGA-800-15, BNPGA-900-15 and BNPGA-1000-5, BNPGA-1000-10 measured at 77K. Detailed analysis was concluded in **Table 1.**

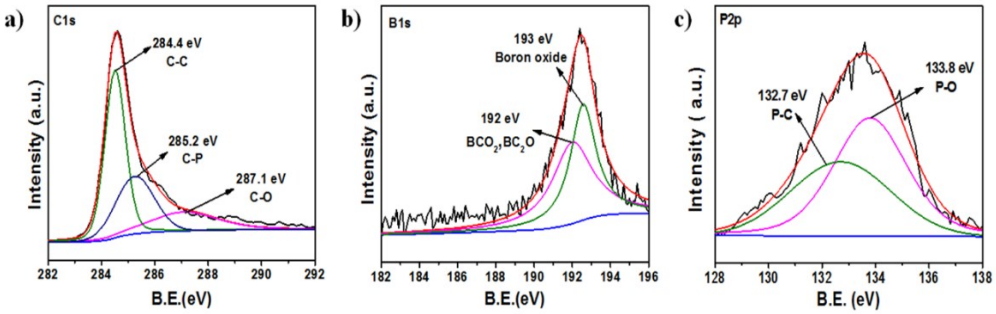

Fig. S2. (a) C 1s, **(b)** B 1s, and **(c)** P 2p XPS signals for BPGA

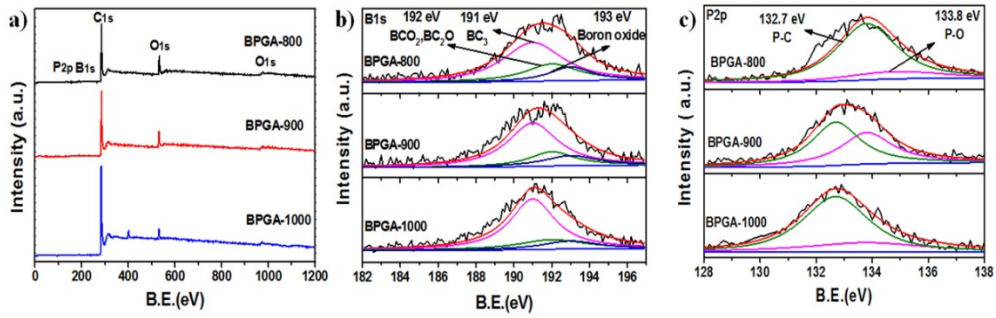

Fig. S3 (a) XPS survey spectra and **(b)** B 1s, **(c)** P 2p XPS signals for BPGA-800, BPGA-900, BPGA-1000.

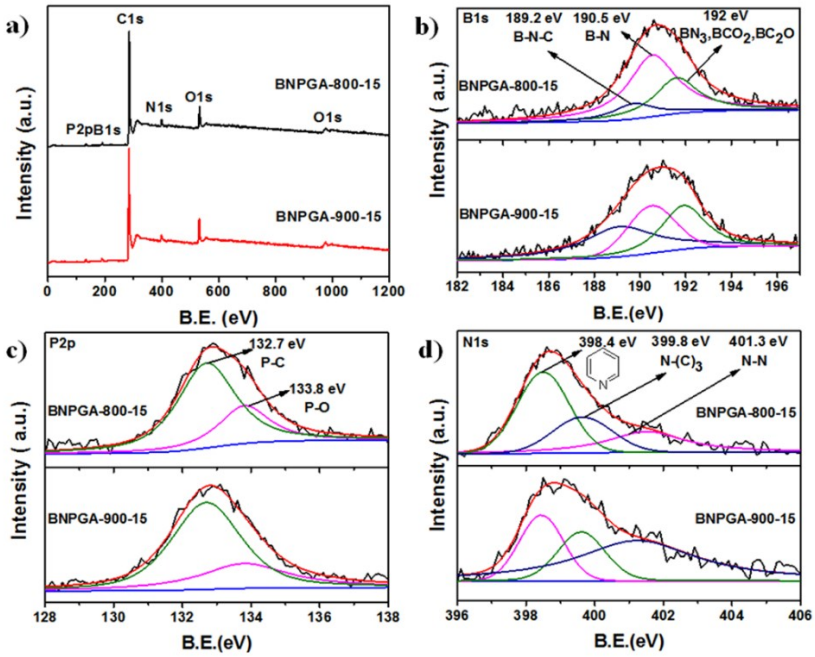

Fig. S4 (a) XPS survey spectra and **(b)** B1s, **(c)** P2p, **(d)** N1s XPS signals for BNPGA-800-15, BNPGA-900-15.

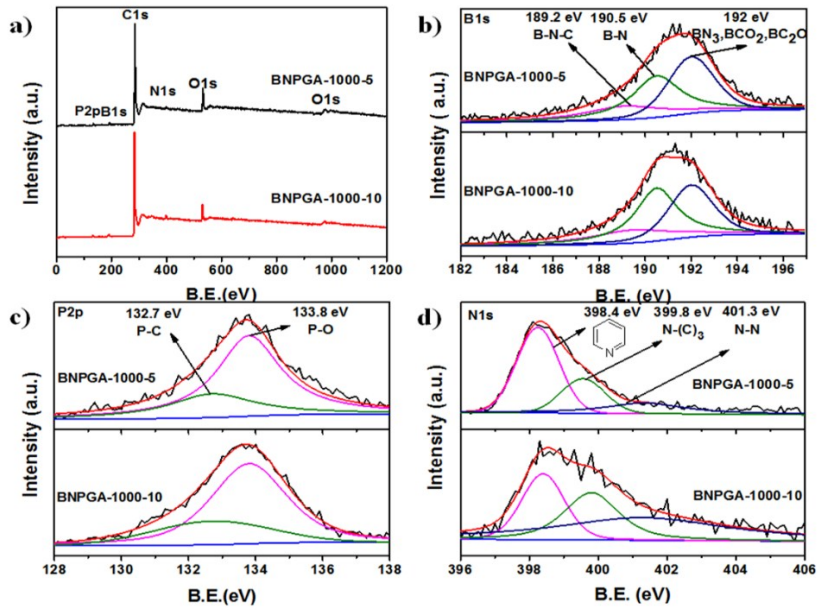

Fig. S5 (a) XPS survey spectra and **(b)** B1s, **(c)** P2p, **(d)** N1s XPS signals for BNPGA-1000-5, BNPGA-1000-10.

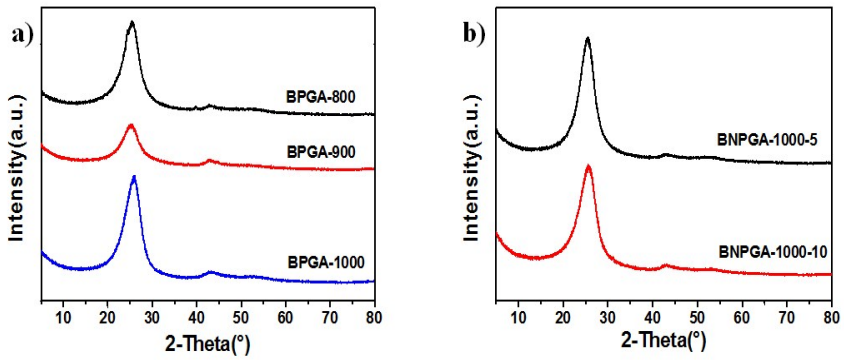

Fig. S6 XRD patterns of **(a)** BPGA-800, BPGA-900, BPGA-1000 and **(b)** BNPGA-1000-5, BNPGA-1000-10.

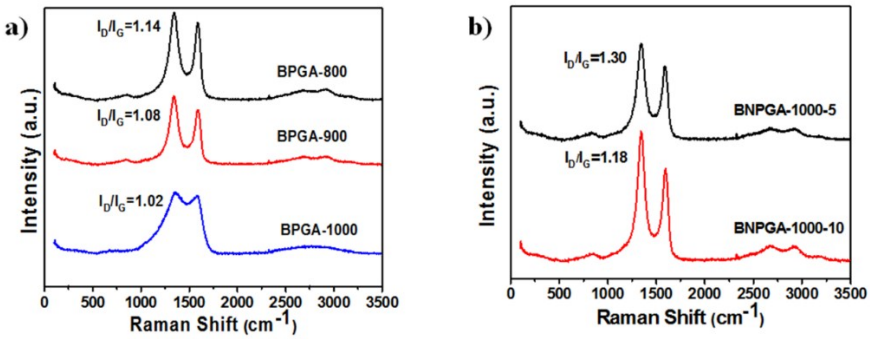

Fig. S7 Raman spectra of **(a)** BPGA-800, BPGA-900, BPGA-1000 and **(b)** BNGA-1000-5, BNPGA-1000-10.

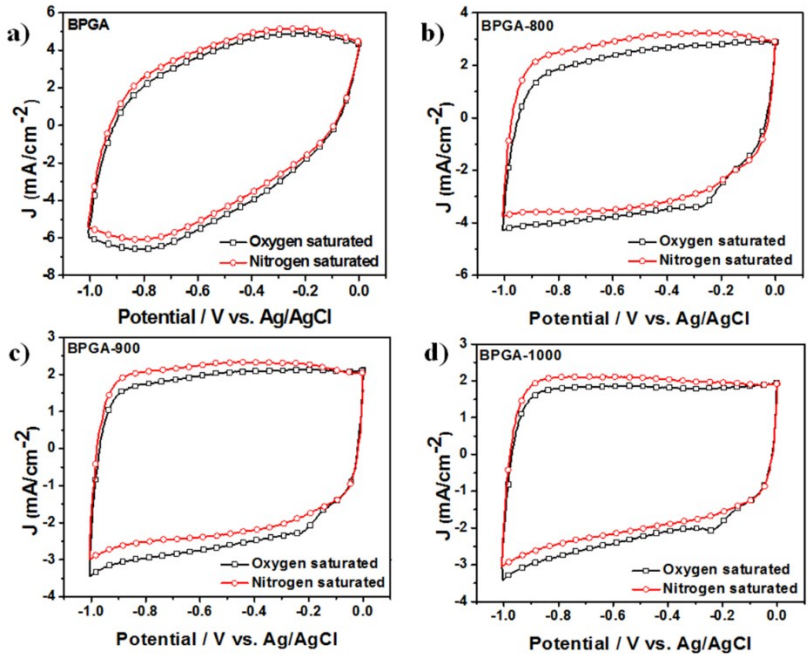

Fig. S8 Cyclic volutammograms of **(a)** BPGA, **(b)** BPGA-800, **(c)** BPGA-900 and **(d)** BPGA-1000 at a scan rate of 100 mV s^{-1} in O_2 and N_2-saturated 0.1M KOH solution.

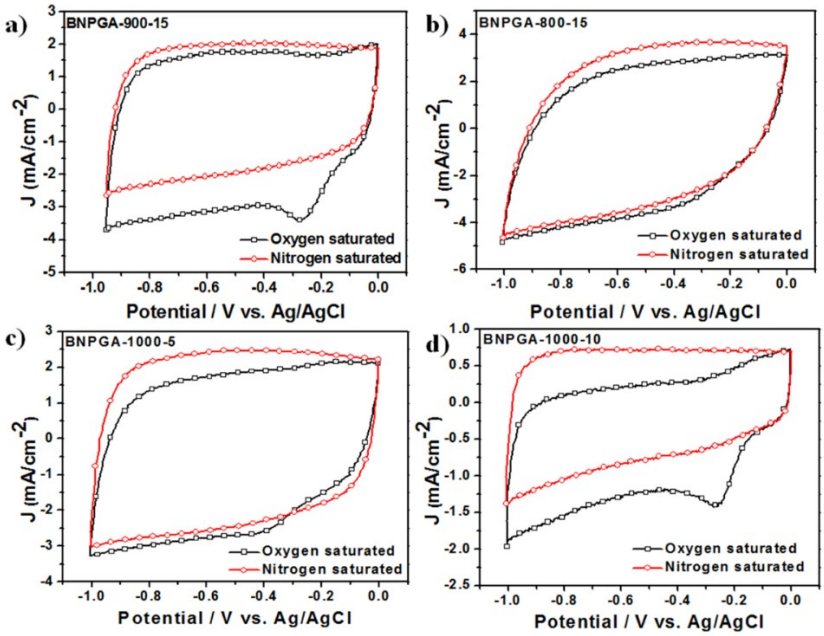

Fig. S9 Cyclic volutammograms of **(a)** BNPGA-800-15, **(b)** BNPGA-900-15, **(c)** BNPGA-1000-5 and **(d)** BNPGA-1000-10 at a scan rate of 100 mV s^{-1} in O_2 and N_2-saturated 0.1 M KOH solution.

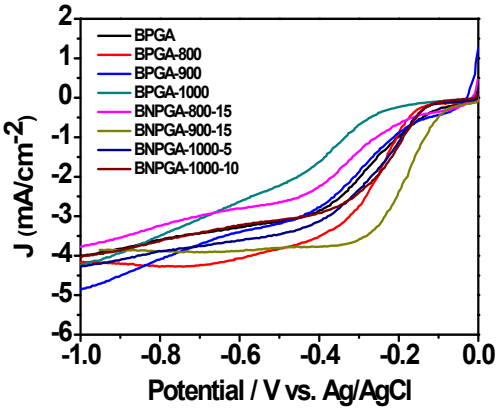

Fig. S10 LSVs of BPGA, BPGA-X, BNPGA-X-Y and commercial Pt/C at a rotation rate of 1600 rpm with a scan rate of 10 mV s^{-1} in O_2- saturated 0.1 M KOH solution

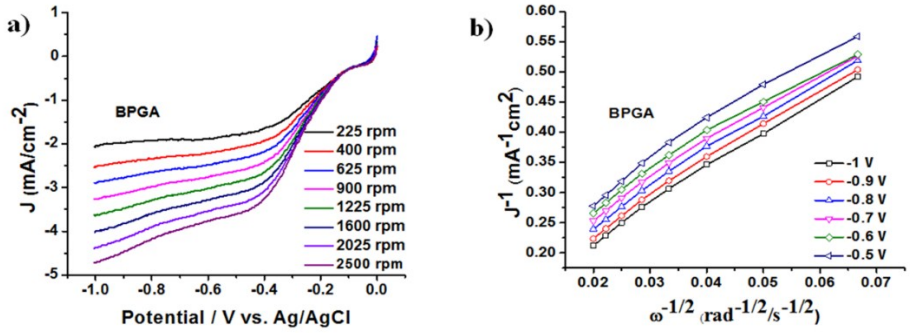

Fig. S11 (a) RDE voltammograms of BNPGA at different rotating speeds with a scan rate of 10 mV s^{-1} in O_2-saturated 0.1 M KOH solution.**(b)** Koutecky–Levich plots of j^{-1} versus $\omega^{-1/2}$ of the BNPGA at potentials of -0.5, -0.6, -0.7, -0.8, -0.9 and -1.0 V.

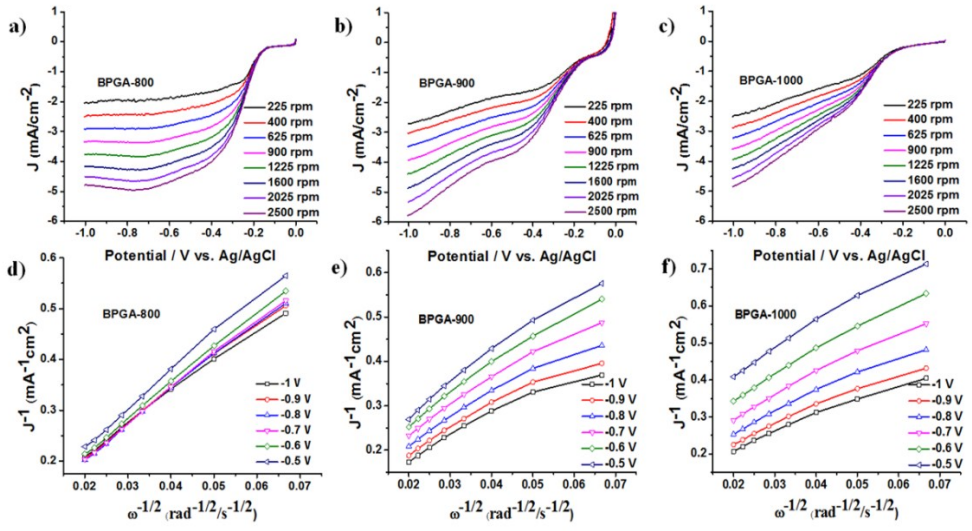

Fig. S12 (a), **(b)**, **(c)** RDE voltammograms of BPGA-800, BPGA-900 and BPGA-1000 at different rotating speeds with a scan rate of 10 mV s^{-1} in O_2-saturated 0.1 M KOH solution. **(d)**, **(e)**, **(f)** Koutecky–Levich plots of j^{-1} versus $\omega^{-1/2}$ of the BPGA-800, BPGA-900 and BPGA-1000 at potentials of -0.5, -0.6, -0.7, -0.8, -0.9 and -1.0 V.

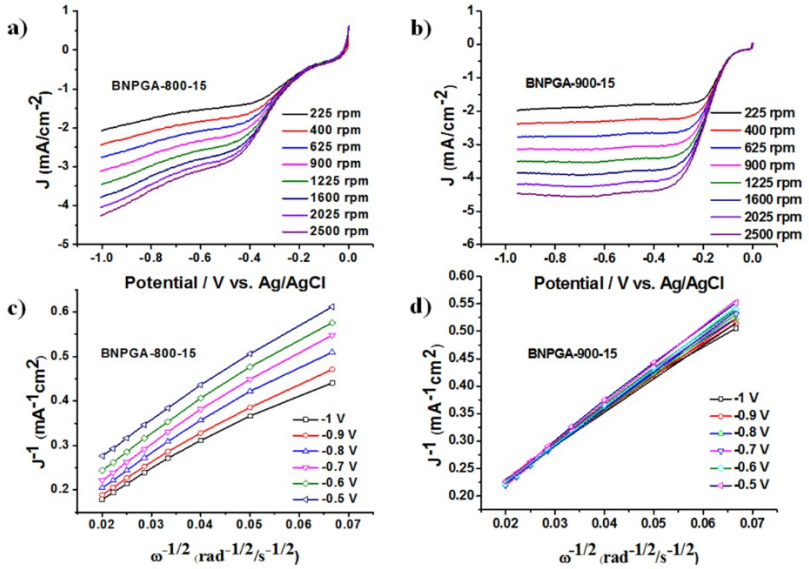

Fig. S13 (a), **(b)** RDE voltammograms of BNPGA-800-15 and BNPGA-900-15 at different rotating speeds with a scan rate of 10 mV s^{-1} in O_2-saturated 0.1 M KOH solution. **(c)**, **(d)** Koutecky–Levich plots of j^{-1} versus $\omega^{-1/2}$ of the BNPGA-800-15 and BNPGA-900-15 at potentials of -0.5, -0.6, -0.7, -0.8, -0.9 and -1.0 V.

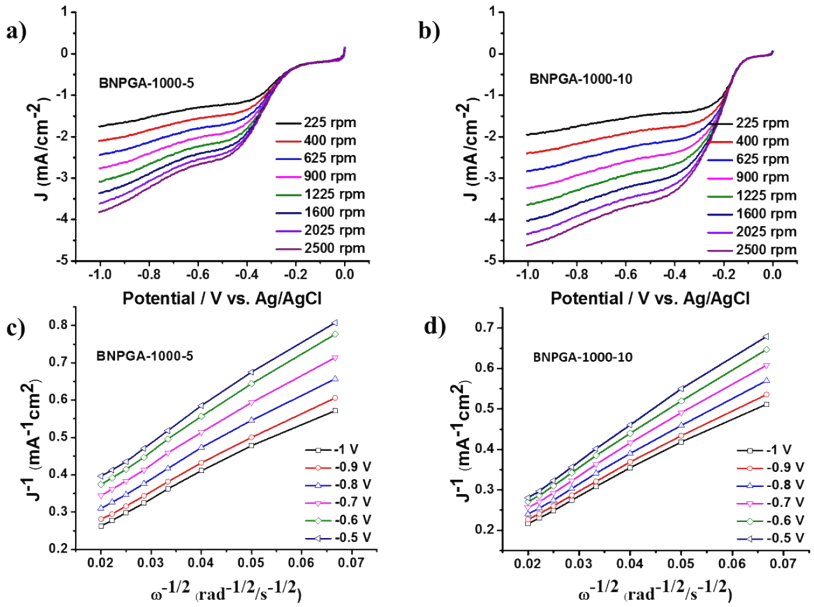

Fig. S14 (a), **(b)** RDE voltammograms of BNPGA-1000-5 and BNPGA-1000-10 at different rotating speeds with a scan rate of 10 mV s^{-1} in O_2-saturated 0.1 M KOH solution. **(c)**, **(d)** Koutecky–Levich plots of j^{-1} versus $\omega^{-1/2}$ of the BNPGA-1000-5 and BNPGA-1000-10 at potentials of -0.5, -0.6, -0.7, -0.8, -0.9 and -1.0 V.

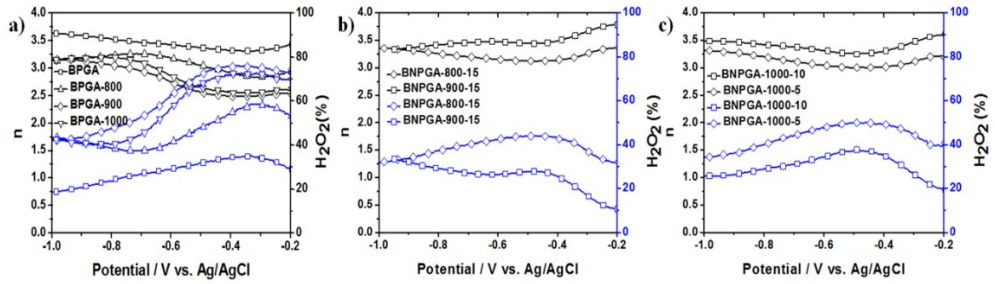

Fig. S15 The calculated electron transfer numbers (n) and percentage of H_2O_2 of **(a)** BPGA, BPGA-800, BPGA-900, BPGA-1000, **(b)** BNPGA-800-15, BNPGA-900-15 and **(c)** BNPGA-1000-5, BNPGA-1000-10.

Table S1. Elemental analysis based on XPS analysis.

Samples	C	O	B	N	P	B/C	N/C	P/C
	Weight content (%)							
BPGA	70.99	20.73	4.90	-	3.38	0.07	-	0.05
BPGA-800	77.42	12.10	5.39	-	5.09	0.07	-	0.07
BPGA-900	82.01	10.29	4.02	-	3.68	0.05	-	0.04
BPGA-1000	91.05	4.87	2.12	-	1.97	0.02	-	0.02
BNPGA-800-15	82.26	8.03	3.81	2.83	3.07	0.05	0.03	0.04
BNPGA-900-15	81.97	8.15	4.05	2.17	3.66	0.05	0.03	0.04
BNPGA-1000-15	77.70	8.10	6.53	4.50	3.17	0.08	0.06	0.04
BNPGA-1000-10	82.70	7.59	3.73	2.18	3.80	0.05	0.03	0.04
BNPGA-1000-5	79.14	10.43	5.02	1.98	3.43	0.06	0.03	0.04