Electronic Supplementary Information

Graphene Edges Enhanced Anchoring of Well Exposed Cobalt

Clusters via Strong Chemical Bonding for Accelerating Oxygen

Reduction Reaction

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Fig. S1. (A) Raman spectrum of CNTs, the strong D peak intensity of CNTs indicated existence of large amount of *sp3*-carbon in CNTs, (B) Raman spectrum of GO-8, GO-9 and GO-10 respectively.



Fig. S2. (A) Full and (B) Mn2p XPS spectrums for GO-8, GO-9 and GO-10. It can be seen that purification treatment has effectively removed impurities especially that of Mn.



Figure S3. TEM images of GO-8 synthesized at mass ratio of 1:8 for CNT and KMnO₄ under 40 °C for 1 hour before 2 hours complete reaction time and quickly collected from reactor followed by purification and drying.



Figure S4. The Fourier Transforms of k^2 -weighted EXAFS spectra in R space for Co-NG-9, Co foil, Co₃O₄, Co₂O₃ and CoO for comparison.



Figure S5. XRD pattern of Co-NG-9.



Figure S6. Co2p XPS spectrums of (A) Co-NG-8 and (B) Co-NG-10.



Figure S7. N1s XPS spectrums of (A) Co-NG-8, (B) Co-NG-10, (C) NG-8 and (D) NG-10.



Figure S8. O1s XPS spectrums of (A) GO-8, (B) GO-9, (C) GO-10, (D) NG-8, (E) NG-9, (F) NG-10, (G) Co-NG-8, (H) Co-NG-9 and (I) Co-NG-10.



Figure S9. C1s XPS spectrums of (A) GO-8, (B) GO-9, (C) GO-10, (D) NG-8, (E) NG-9, (F) NG-10, (G) Co-NG-8, (H) Co-NG-9 and (I) Co-NG-10.

	С	0	Ν	Of total nitrogen (%)				Со
	(at%)	(at%)	(at%)	Pyri-N	Pyrro-N	Grap-N	N oxide	(at%)
NG-8	92.23	3.65	4.12	39.67	25.48	23.52	11.33	-
NG-9	91.26	3.61	5.13	41.18	22.34	22.7	13.78	-
NG-10	90.35	4.27	5.28	47.69	22.72	15.51	14.08	-
NG-8-HT	83.41	11.05	5.54	31.52	47.83	14.69	5.96	-
NG-9-HT	80.26	13.26	6.48	25.71	46.13	14.91	13.25	-
NG-10-HT	79.26	14.07	6.67	24.8	47.04	15.23	12.93	-
Co-NG-8	88.82	3.52	7.13	57.53	5.10	22.55	14.82	0.53
Co-NG-9	86.63	3.93	8.89	61.32	7.95	21.17	9.56	0.55
Co-NG-10	85.81	4.65	9.54	59.84	16.92	13.56	9.68	0.56

Table S1. Chemical composition of NG-8, NG-9, NG-10, NG-8-HT, NG-9-HT, NG-10-HT, Co-NG-8, Co-NG-9 and Co-NG-10 via XPS analysis.



Figure S10. (A) CV curves of Co-NG-9 in N_2 saturated 0.1M KOH solution from the scan rate of 2 mV s⁻¹ to 20 mV s⁻¹ in potential range between 0.04 and 0.14 V vs Ag/AgCl, (B) current density versus scan rate for G-8, NG-8, NG-9, NG-10, Co-NG-8, Co-NG-9 and Co-NG-10 respectively.

Catalysts	Current density (mA cm ⁻²)							
	$1 \mathrm{mV} \mathrm{s}^{-1}$	2 mV s ⁻¹	4 mV s ⁻¹	6 mV s ⁻¹	8 mV s ⁻¹	10 mV s ⁻¹	20 mV s ⁻¹	$(mF cm^{-2})$
G-9	0.00349	0.00398	0.00537	0.00659	0.00772	0.00875	0.01328	0.52
NG-8	0.00565	0.00851	0.01432	0.01985	0.02532	0.03063	0.05666	2.68
NG-9	0.01107	0.01622	0.02678	0.03705	0.04696	0.05646	0.10256	4.81
NG-10	0.01745	0.02862	0.05131	0.07334	0.0945	0.11557	0.21716	10.50
Co-NG-8	0.00988	0.01489	0.02541	0.03575	0.04564	0.05544	0.10322	4.91
Co-NG-9	0.02108	0.03254	0.05656	0.08002	0.10266	0.12475	0.23195	11.10
Co-NG-10	0.02324	0.03793	0.06793	0.097	0.12505	0.15259	0.28535	13.78

Table S2. Specific capacitance (C_S) calculated from CV curves of catalysts.



Figure S11. Nyquist plots obtained at 0.791 V vs RHE (-0.2 V vs Ag/AgCl) for various samples.



Figure S12. Nyquist plots obtained at 1.081 V vs RHE (0.09 V vs Ag/AgCl) for various samples.



Figure S13. N1s XPS spectrums of (A) NG-8-HT, (B) NG-9-HT and (C) NG-10-HT.