Supporting Information

Reduced graphene oxide-supported cobalt oxide decorated N-doped graphitic carbon for efficient bifunctional oxygen electrocatalysis

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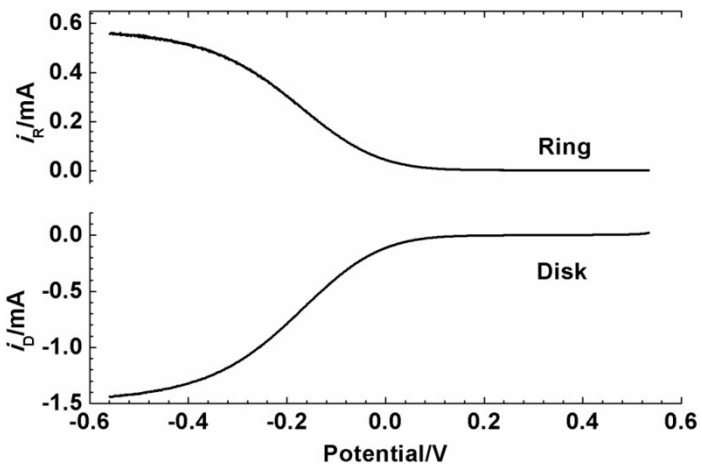

Figure S1. Ring ($Fe^{2+} \rightarrow Fe^{3+} + e^-$) and disk ($Fe^{3+} + e^- \rightarrow Fe^{2+}$) currents for the determination of collection efficiency of RRDE loaded with N-GC/Co@CoO/rGO catalyst. The electrolyte is degassed 0.1 M NaOH with 0.01 M $K_3Fe(CN)_6$. The rotation speed of RRDE is 1,600 rpm. The collection efficiency is calculated to be (35.2 ± 0.2)%, which is close to the manufacturer's data 37%.

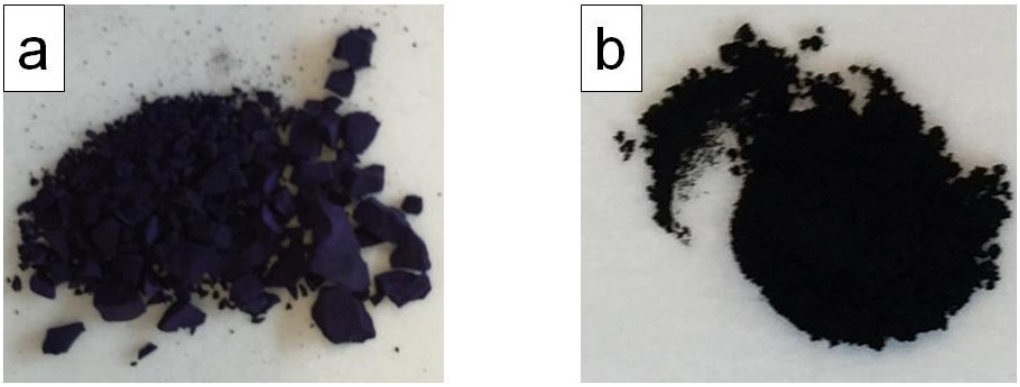

Figure S2. Digital pictures of (a) rGO-ZIF-67 and (b) N-GC/Co@CoO/rGO.

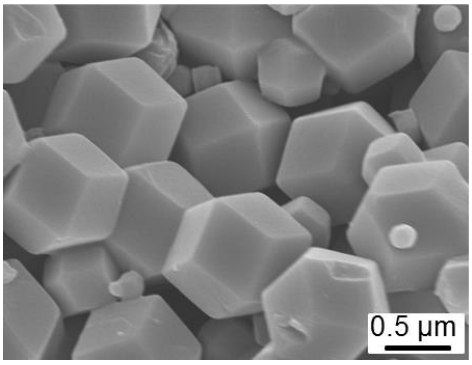

Figure S3. SEM image of ZIF-67.

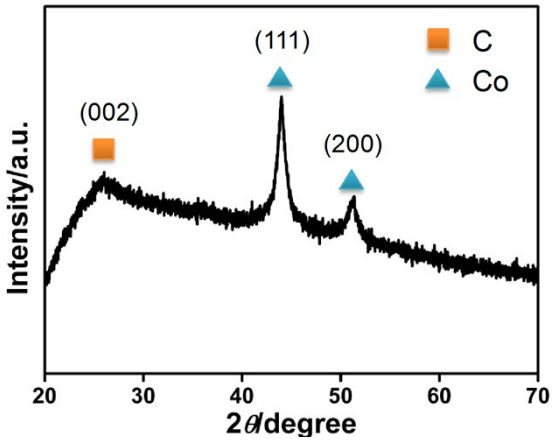

Figure S4. XRD pattern of N-GC/Co/rGO.

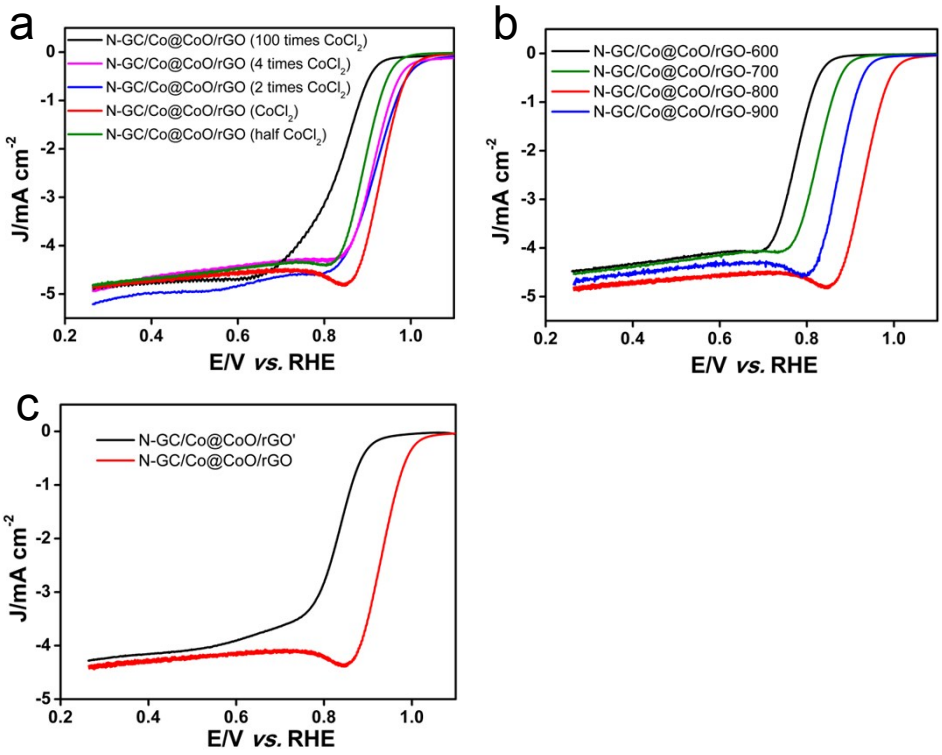

Figure S5. LSV curves of (a) N-GC/Co@CoO/rGO nanocomposite prepared with different molar ratios between GO and $CoCl_2$ precursors, (b) N-GC/Co@CoO/rGO nanocomposite carbonized under different temperature and (c) N-GC/Co@CoO/rGO nanocomposite prepared in our method and N-GC/Co@CoO/rGO' synthesized according to a previous report.[1] All of the curves were obtained at a rotation speed of 1,600 rpm in 0.1 M KOH.

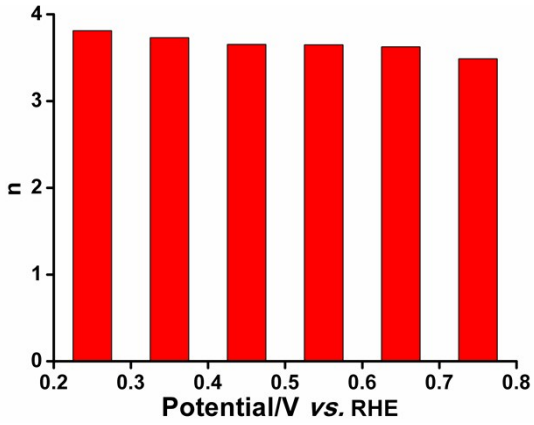

Figure S6. The number (n) of electrons transferred per oxygen molecule (O_2) during ORR for N-GC/Co@CoO/rGO obtained from its Koutecky-Levich plots shown in **Figure 4c**.

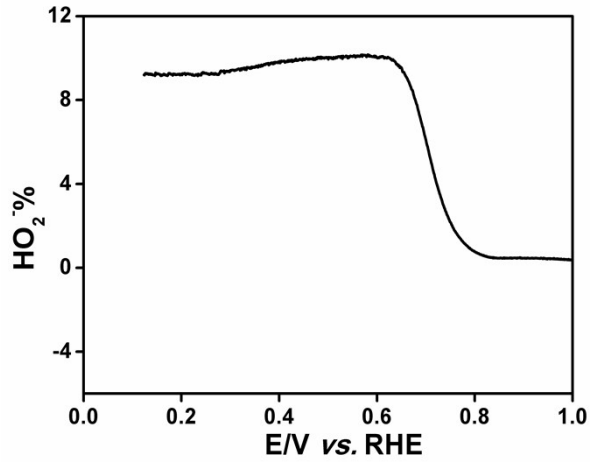

Figure S7. Calculation result of measured yield of HO_2^- using K-L equation (see Experimental Section in detail) based on RRDE result (**Figure 4d**).

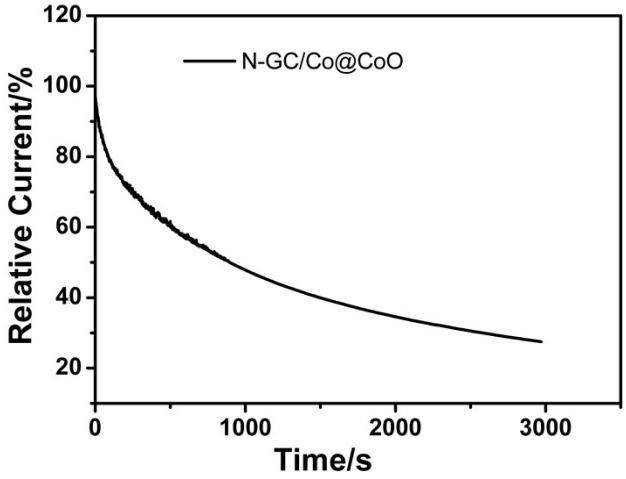

Figure S8. Chronoamperometric response of N-GC/Co@CoO at 0.7 V in O_2-saturated 0.1 M KOH aqueous solution.

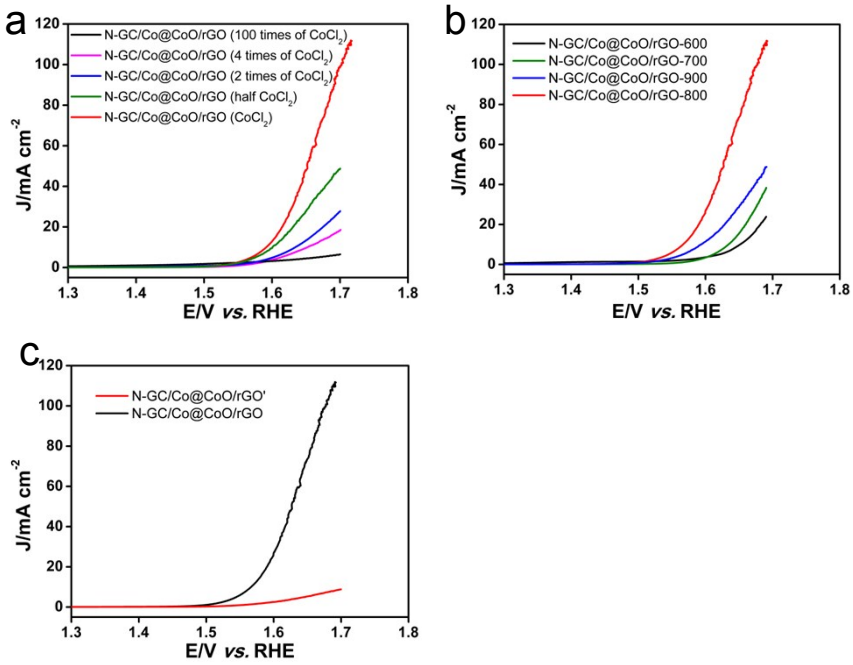

Figure S9. LSV curves of (a) N-GC/Co@CoO/rGO prepared with different molar ratios between GO and $CoCl_2$ precursors, (b) N-GC/Co@CoO/rGO carbonized under different temperature and (c) N-GC/Co@CoO/rGO prepared in our method and N-GC/Co@CoO/rGO' synthesized according to a previous report[1] at a rotation speed of 1,600 rpm in 0.1 M KOH.

Table S1. Comparison of electrochemical properties of N-GC/Co@CoO/rGO with recently reported electrocatalysts.

Electrocatalysts	Onset potential (V_{ORR}, V)	Electrolyte used in the ORR characterization	V_{OER} (mV) at 10 mA cm^{-2}	Electrolyte used in the OER characterization	Referenc-e
N-GC/Co@CoO/rGO	0.99	0.1 M KOH	350	1.0 M KOH	this work
CoNi-MOF/rGO	0.88	1.0 M KOH	318	0.1 M KOH	2
$F_{0.2}N_{0.2}M_{0.2}$-900	0.839	0.1 M KOH	416	0.1 M KOH	3
NiFe@NC_X	1.03	0.1 M KOH	320	0.1 M KOH	4
N-PC@G-0.02	1.01	0.1 M KOH	400	0.1 M KOH	5
FeCo@MNC	0.88	0.1 M KOH	240	0.1 M KOH	6
Co-NCNFs-800	0.907	0.1 M KOH	456	0.1 M KOH	7
Co-C_3N_4/CNT	0.90	0.1 M KOH	380	0.1 M KOH	8

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