Supporting information

Highly Efficient Bifunctional Electrocatalyst (ORR/OER) Derived from GO Functionalized with Carbonyl, Hydroxyl and Epoxy Groups for Rechargeable Zinc-Air Batteries

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Electrochemical measurements

A conventional three-electrode system was employed to evaluate the electro-catalytic performance of the obtained catalyst on a CHI 760E electrochemical workstation. A rotating disk electrode (RDE) with a glassy carbon (GC) disk (electrode area: 0.1256 cm^2) was used as the working electrode, Ag/AgCl was used as the reference electrode, and platinum wire was used as the counter electrode. The rotating ring disk electrode measurements for ORR were carried out on RRDE in a N_2 or O_2-saturated 0.1 M KOH electrolyte solution at a scan rate of 10 mV/s. The rotating ring disk electrode measurements for OER was carried out in 1 M KOH electrolyte solution at a scan rate of 10 mV/s. For ORR, before the electrochemical measurements, the electrolyte solution was purged with O_2 for 30 min to achieve an O_2-saturated solution, and stable polarization curves were recorded after 20 cycles. All the potentials were converted to the potential versus the reversible hydrogen electrode (RHE) according to $E_{vs}RHE = E_{vs}Ag/AgCl + E_{ø}Ag/AgCl + 0.059$ pH.

Rotating ring-disk electrode (RRDE) measurements were recorded with catalyst inks and electrodes prepared by the same method as that for the RDE measurements. The H_2O_2 produced and the electron number (n) transferred during the ORR were

calculated using the following equations:

$$n = 4\frac{I_D}{I_D + I_R/N}$$

$$H_2O_2\% = 100 \times \frac{4-n}{2}$$

The rotating ring-disk electrode was employed to detect the H_2O_2 yield, where the ring potential was set to 1.3 V (vs. RHE). where I_D is the Faradaic current at the disk, I_R is the Faradaic current at the ring, and N= 0.37 is the collection efficiency of ring electrode.
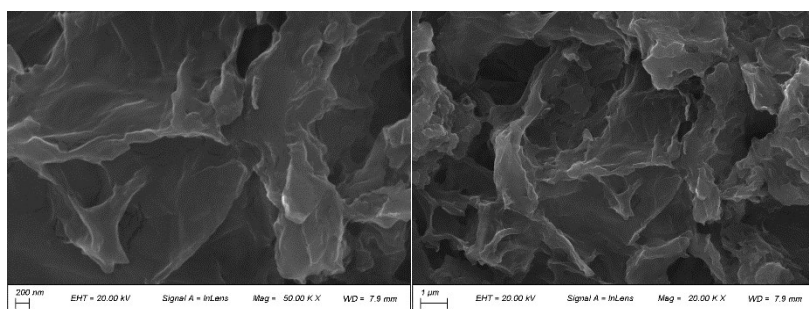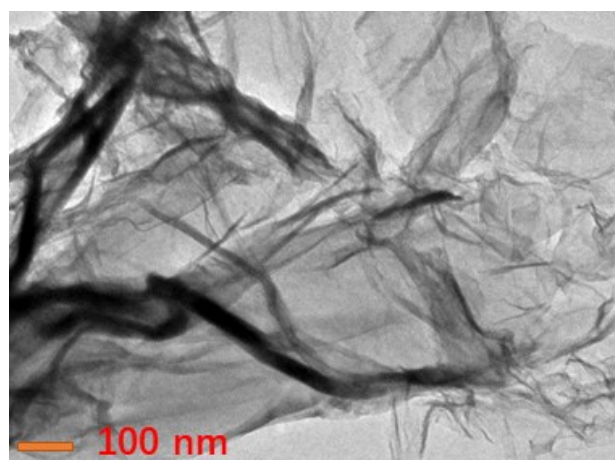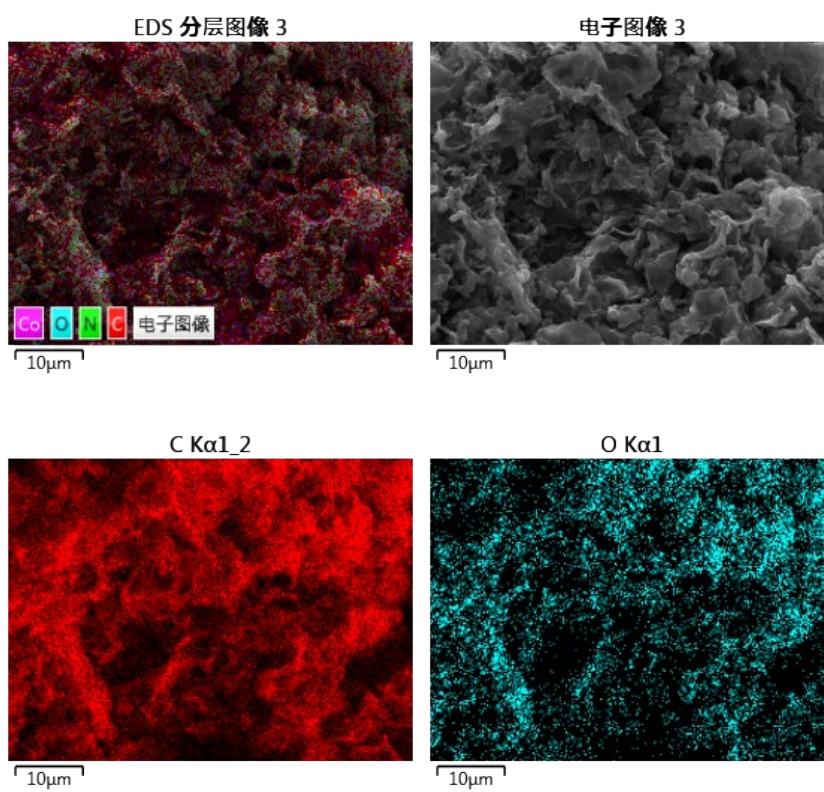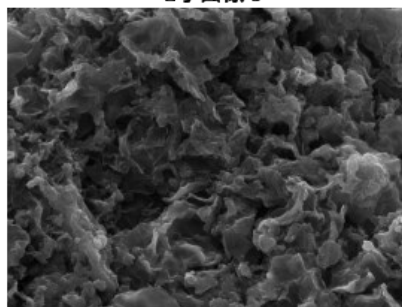

Fig. S1 SEM of Co-N/rGO.

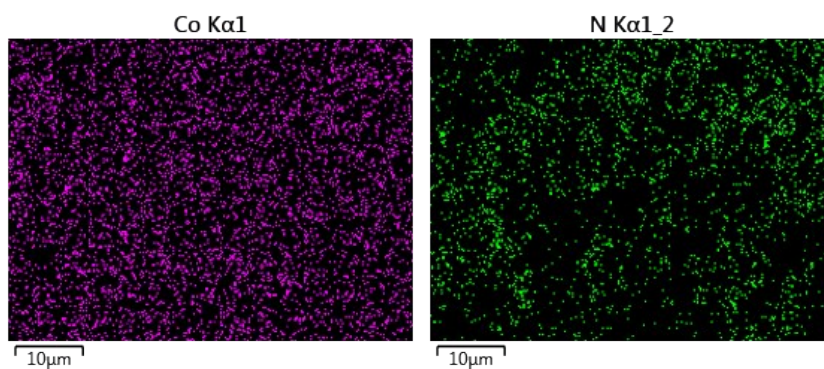**Fig. S2** TEM of Co-N/rGO.

Co Kα1   N Kα1_2
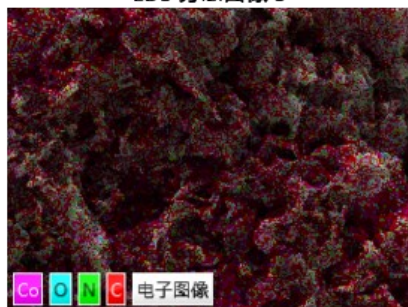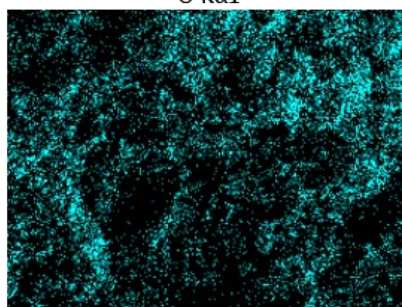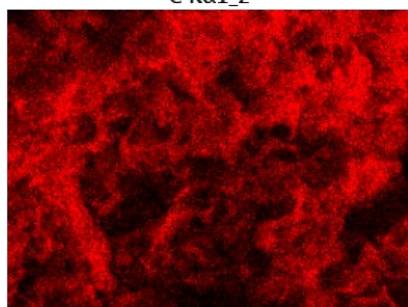
Fig. S3 EDS of Co-N/rGO.
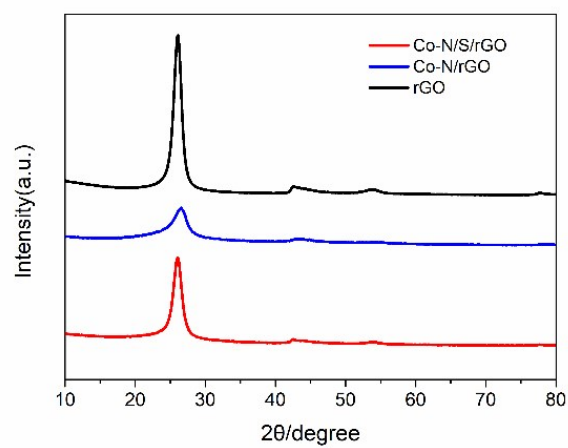

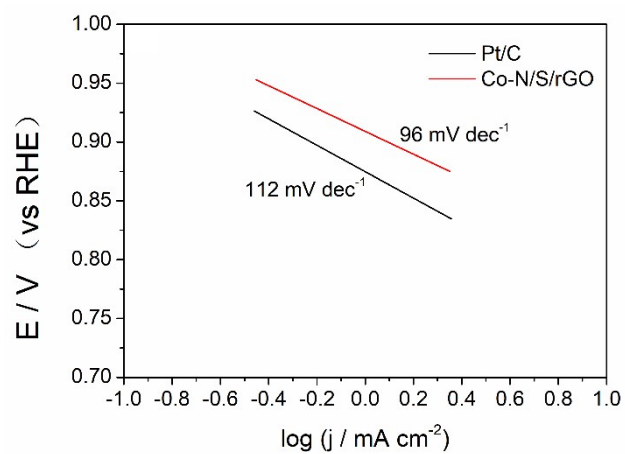**Fig. S4** XRD of Co-N/S/rGO, Co-N/rGO and rGO.

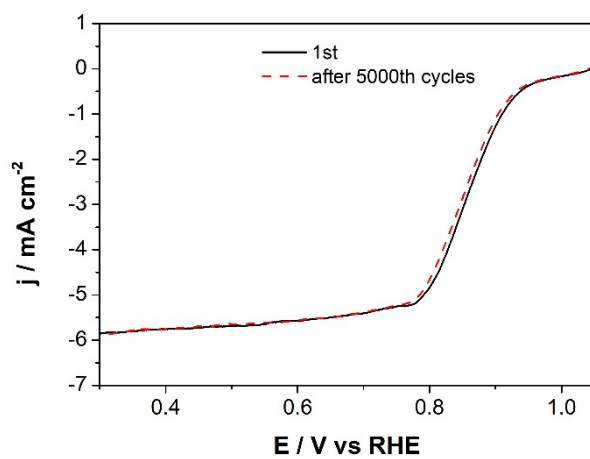**Fig. S5** Tafel plots of Co-N/S/rGO and Pt/C for ORR.

Fig. S6 LSVs of Co-N/S/rGO catalysts before and after 5000 cycles in O_2-saturated 0.1 M KOH.
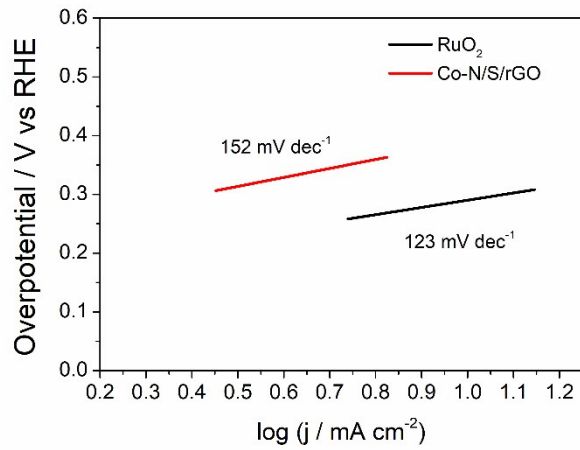
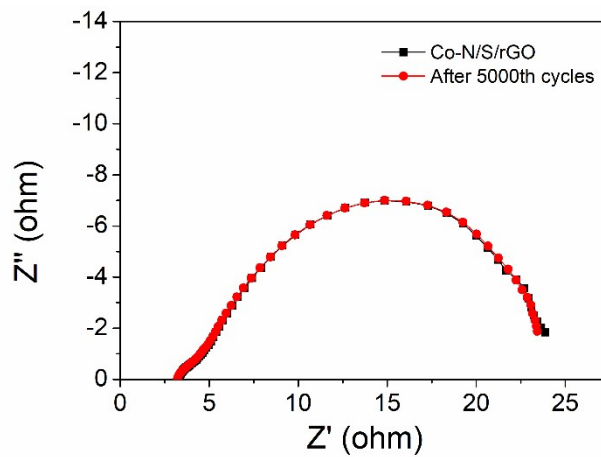**Fig. S7** Tafel plots of Co-N/S/rGO and Pt/C for OER.

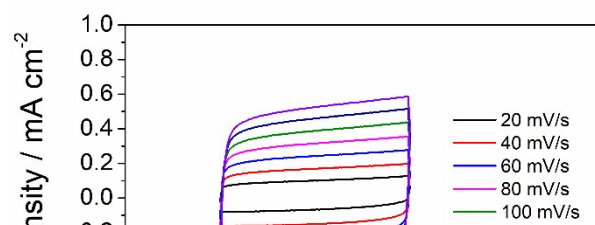**Fig. S8** EIS of Co-N/S/rGO catalysts before and after 5000 cycles in 1 M KOH for OER.

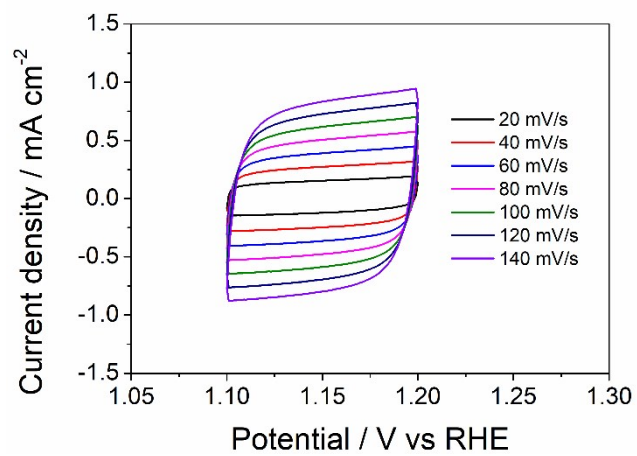**Fig. S9** CV curves of Co-N/rGO at different scan rates in 1.0 M KOH solution.

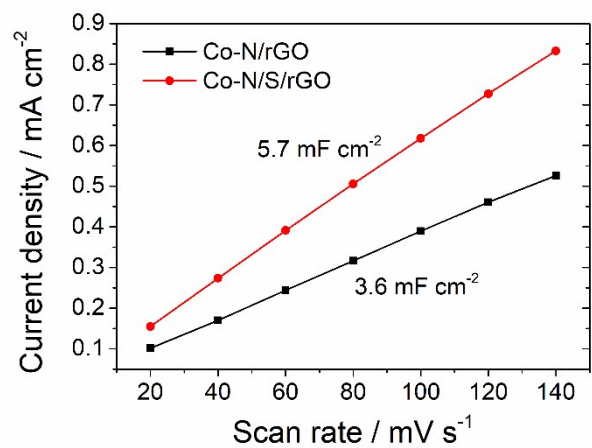**Fig. S10** CV curves of Co-N/S/rGO at different scan rates in 1.0 M KOH solution.

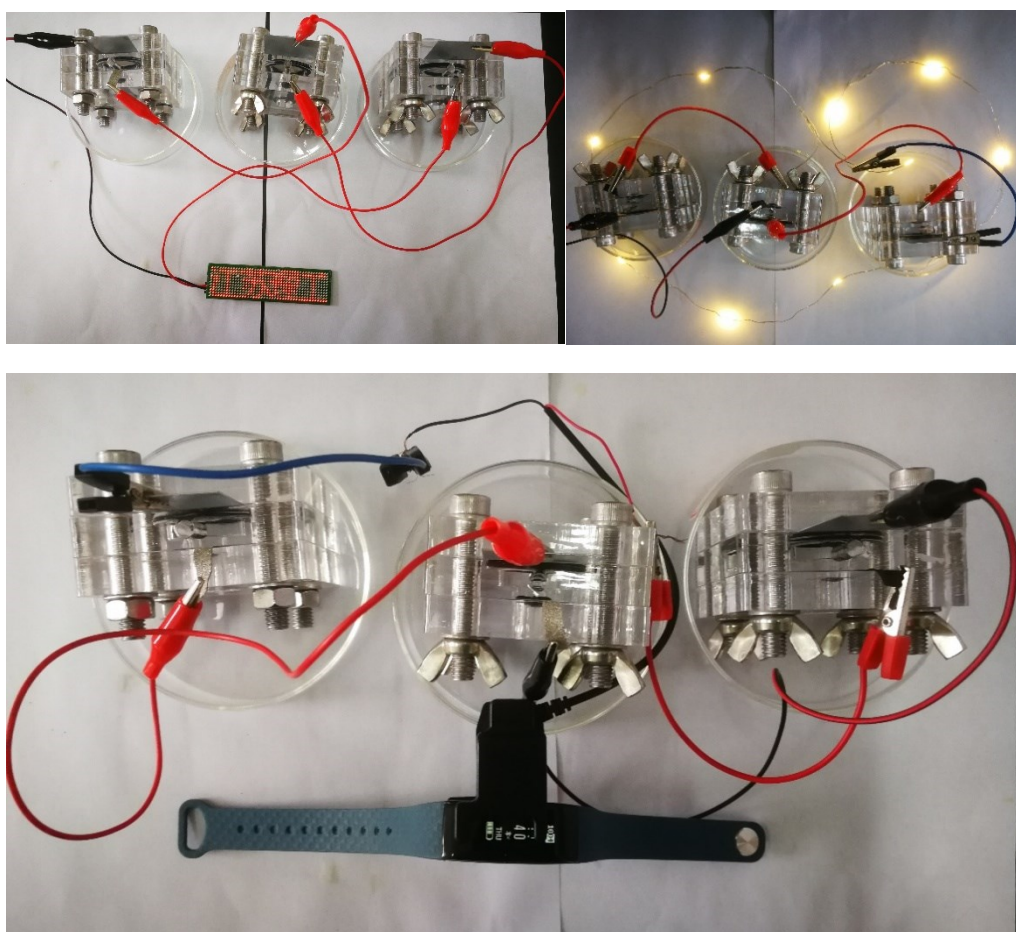**Fig. S11** Double-layer capacitance for different samples.

Fig. S12 Images of the Co-N/S/rGO based ZABs in series power a light emitting diode (LED) array and charge the smart bracelet, the working voltage is 3.7-5 V.