Supporting Information

Co_3O_4 Nanoparticles Decorated Carbon Nanofiber Mat as Binder-Free Air-Cathode for High Performance Rechargeable Zinc-Air Batteries

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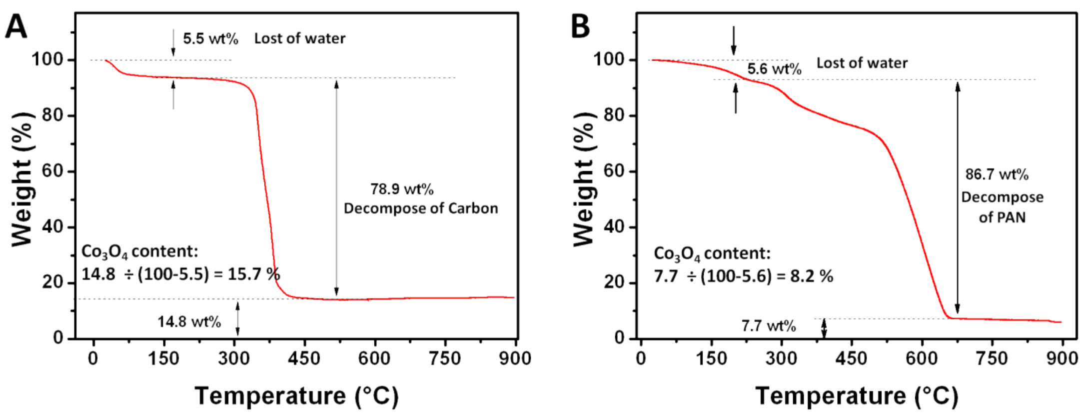

Fig. S1 TGA curves measured in air atmosphere from 30°C to 900°C at a heating rate of 10°C per min. A) C–CoPAN900, B) as electrospun Co(II) –PAN fiber.

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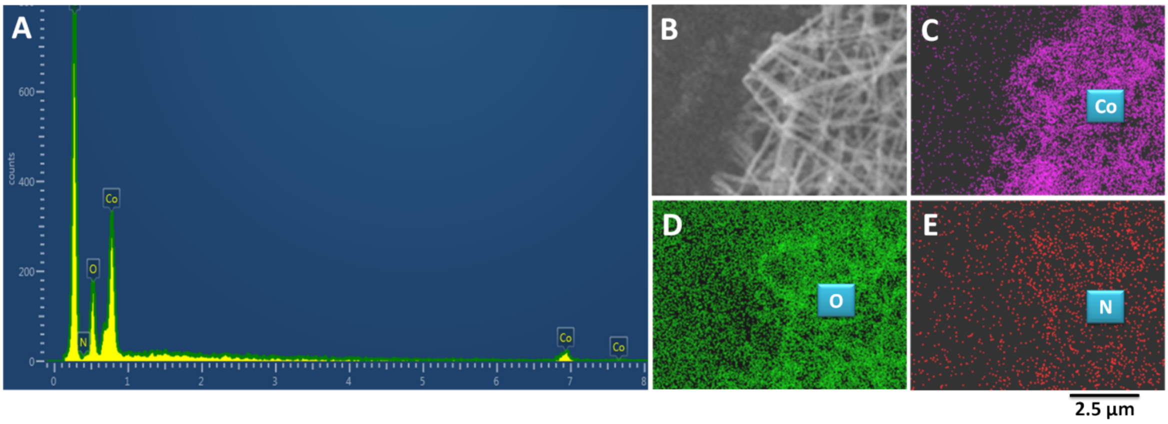

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ig. S2 A) EDX spectra of the C–CoPAN900. B) SEM image of the C–CoPAN900, and (C-E) are the corresponding elemental mapping for Co, O and N of the same area in (B), respectively.

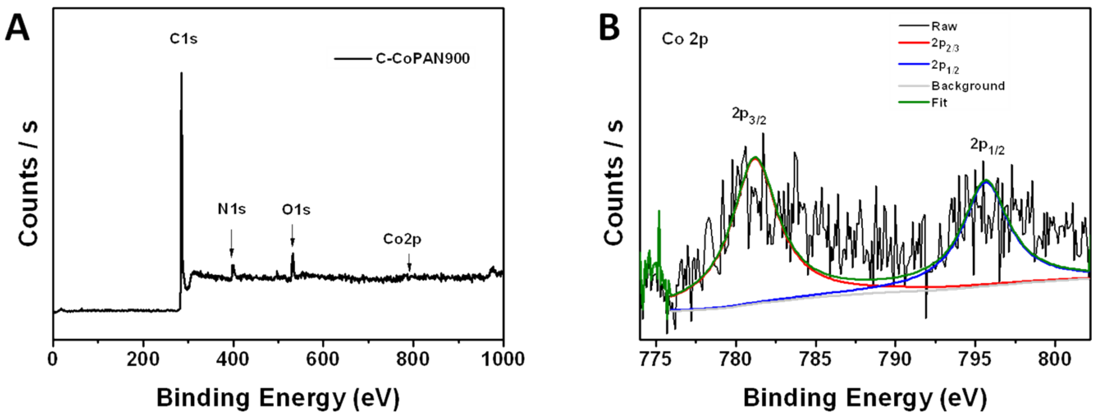

Fig. S3 XPS spectra of the C–CoPAN900. A) Survey spectrum. B) High resolution Co2p spectrum.

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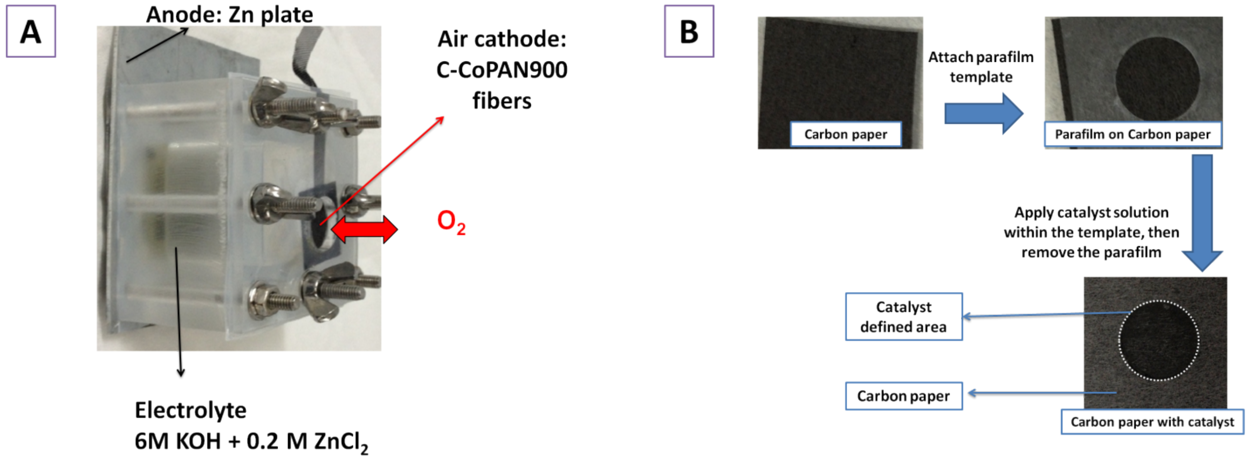

Fig. S4 A) Photo of a home-built Zn-Air cell. B) Schematic showing the preparation of conventional catalyst electrode. A piece of parafilm with a pre-punched hole was used for better controlling the catalyst loading and deposition area.

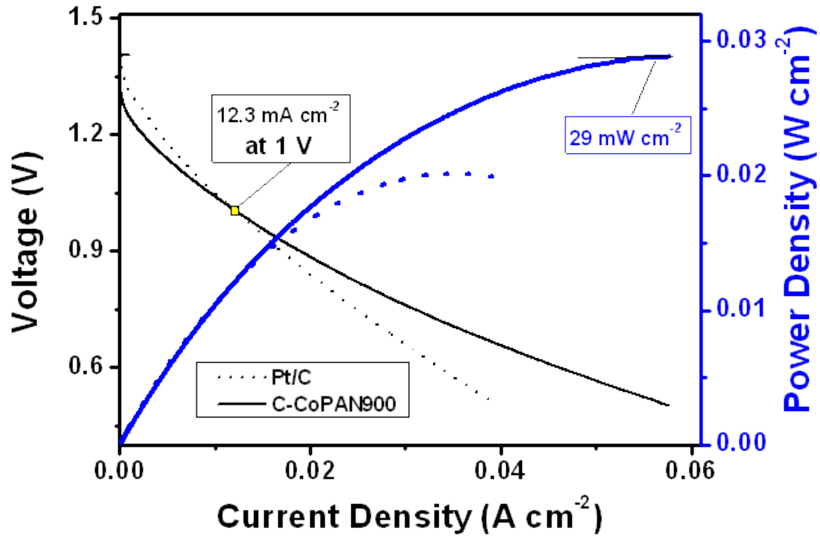

Fig. S5 Polarization curves (*V– i)* (black lines) and corresponding power density plots (blue lines) of the battery using conventional type cathode of C–CoPN900 (solid lines) and commercial Pt/C catalyst (dotted lines).

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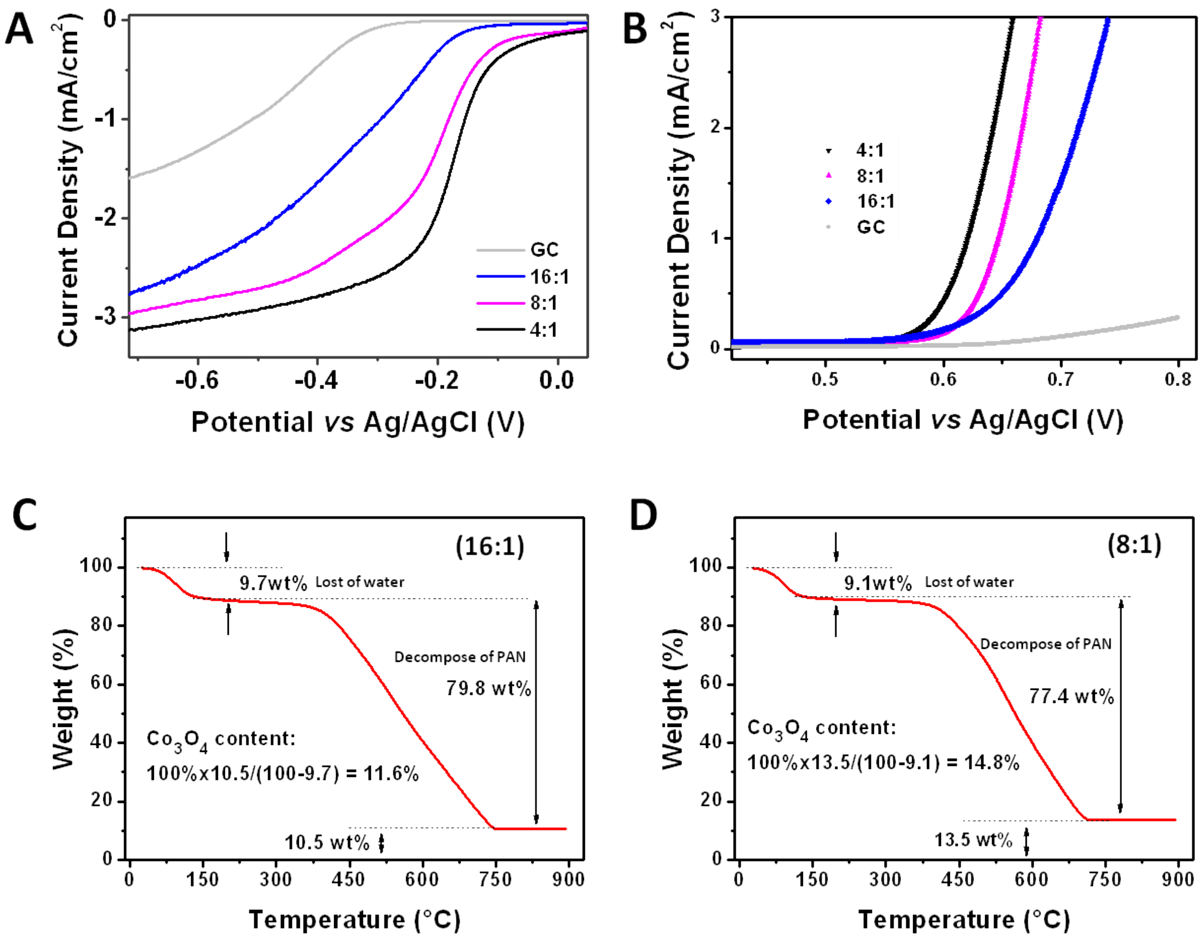

Fig. S6 Electrocatalytic performances of hybrid CNFs obtained from precursors prepared at different weight ratios of PAN: cobalt acetate including 4:1(the C-CoPAN900), 8:1 and 16:1. A) and B) LSV curves of the hybrid CNFs for ORR and OER, respectively. The electrode rotating speed was 900 rpm. From TGA results, the corresponding Co_3O_4 content for the samples of 16:1 C) and 8:1 D) were 11.6% and 14.8%, respectively. TGA were measured in air atmosphere from 30°C to 900°C at a heating rate of 20°C per min.

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Table S1 A comparison of the Zn-air battery performance of this work with recent literatures with respect to the current density at 1 V and the peak power density.

Air cathode	Zn electrode/ electrolyte	Current density at potential of 1 V (mA cm^{-2})	Peak Power density (mW cm^{-2})	Reference
Integrated electrode of C-CoPAN900 mat	Zn plate/ 6M KOH	81.0	125	This work
C-CoPAN900 loaded on carbon paper	Zn plate/ 6M KOH	12.3	29	This work
Graphene supported Mn_3O_4 NPs loaded on carbon paper	Zn powders/--	70	120	*Energy Environ. Sci.* **2011**, 4, 4148
N-doped CNTs loaded on carbon paper	Zn plate/ 6M KOH	50	75	*Electrochim. Act* **2011**, 56, 5080
MnO_2 nano tubes loaded on carbon paper	Zn plate/ 6M KOH	~22	36	Nanoscale 2013, 5, 4657
MnO_2 /Co_3O_4 hybrids loaded on carbon paper	Zn plate/ 6M KOH	~20	33	*Nanoscale* **2013**, 5, 4657
MnO_2 loaded on carbon paper	Zn sheet/ 6M KOH	~13	19.3	*Electrochim. Acta* **2011**, 56, 6205
$PbMnO_x$ loaded on carbon paper	Zn sheet/ 6M KOH	~29	35	*Electrochim. Acta* **2011**, 56, 6205

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Table S2. A comparison of the Zn-air battery performance of this work with recent literatures in terms of the cycling stability at high current density.

Air catalyst used	Cycling condition and stability	Voltage gap between discharge and charge (V)	Reference
2CoPAN fiber mat	**20 mA/cm^2**; 1h/cycle; >55 cycles; voltage gap increased ~0.1V at the end	~0.85	This work
MnO_2 and CNT composite	**~8 mA/cm^2**; 10min/cycle; 50 cycles; voltage gap increased ~0.4V at the end	1.5	*Electrochim. Acta* **2012**, 69, 295-300
$LaNiO_3$ supported on N-doped CNTs	**~17.6 mA/cm^2**; 10min/cycle; 75 cycles; voltage gap increased ~0.1-0.2V at the end	1.2	*Nano Lett.* **2011**, 11, 5362-5366
Co_3O_4 NP-modified MnO_2 nanotubes	**15 mA/cm^2**; 14min/cycle; 60 cycles; voltage gap increased ~0.3-0.4V at the end	~ 0.85	*Nanoscale,* **2013**, 5, 4657-4661