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Nitrogen Doped and Carbon Coated CoP Hollow Nanospheres with Enhanced Electrocatalytic Activity towards Oxygen Evolution Reaction

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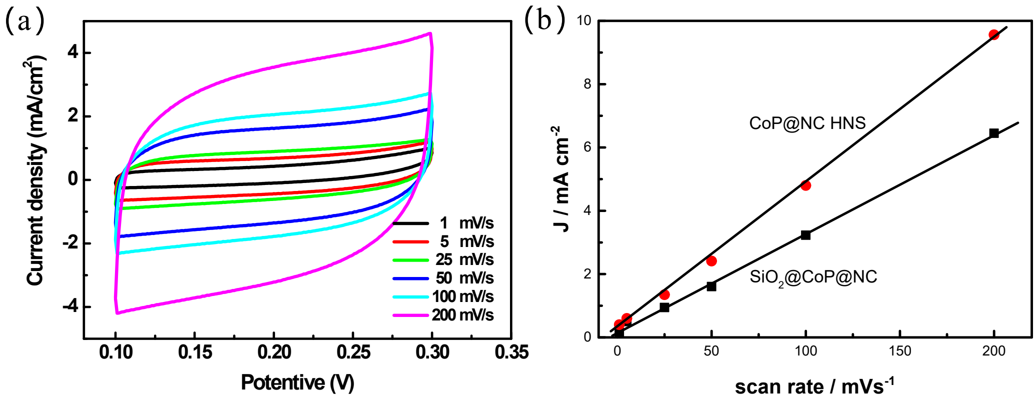

Figure S1. (a) Cyclic voltammograms (CV) curves in 1 M KOH for CoP@NC HNS in the region of 0.10~0.30 V vs. RHE at various scan rates. (b) The measured capacitive currents plotted as a function of scan rate.

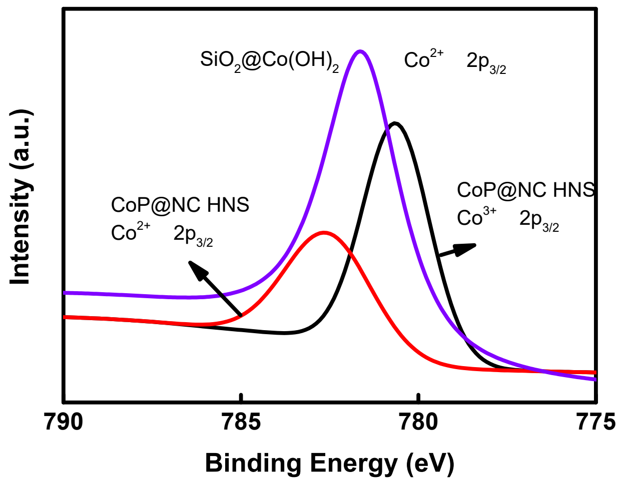

Figure S2. Decomposed XPS Co 2p spectra of the CoP@NC HNS and SiO_2@$Co(OH)_2$.

The Co region of CoP@NC HNS shown in Figure S2 exhibits that the profiles of Co $2p_{3/2}$ of CoP can be deconvoluted into two peaks located at 780.8 eV (Co^{3+}), and 782.6 eV (Co^{2+}). The Co $2p_{3/2}$ peak of SiO_2@$Co(OH)_2$ was at 781.7. Compared with $Co(OH)_2$, the peak of metallic Co is visibly red-shifted in CoP, indicating the enriched electrons around Co, which weakens the oxygen bond on the cobalt surface and effectively promotes the kinetics of the Heyrovsky step.

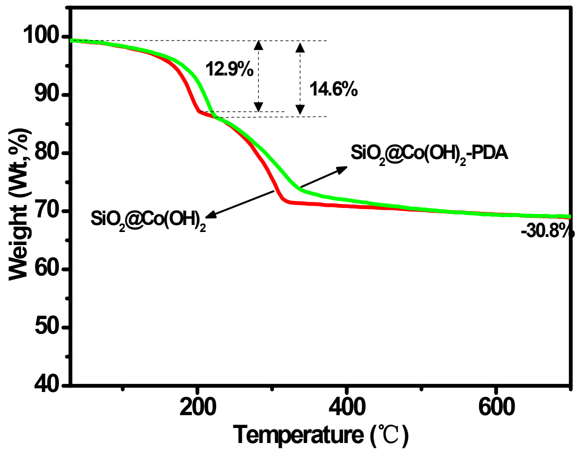

Figure S3. TG curves of SiO_2@$Co(OH)_2$ and SiO_2@$Co(OH)_2$-PDA.

The two TG curves shown in the Figure S3 correspond to SiO_2@$Co(OH)_2$ and SiO_2@$Co(OH)_2$-PDA, respectively. The two TG curves have similar trends. According to the TGA curve of SiO_2@$Co(OH)_2$, the material experienced the first stage of weight loss (12.9%) before the temperature reached 200 ℃. This part of weight loss was due to the removal of water molecules between $Co(OH)_2$ layers. For SiO_2@$Co(OH)_2$-PDA, the first stage of weight loss before the temperature reached 220 ℃ was 14.6% because of the preliminary carbonization of PDA. Then the weight loss from this segment to the end is due to dehydroxylation and the removal of anions between the layers. The total mass loss was 30.8%.

Table S1. A comparison study on OER performances between this work and the other related reports.

Composite materials	**KOH (M)**	**J ($mA\bullet cm^{-2}$)**	**Tafel slope ($mA\ dec^{-1}$)**	**Overpotential (mV)**
RuO_2[1]	1.0	10	114	400
IrO_2[2]	1.0	10	149	395
CoP/rGO-400[2]	1.0	10	64	340
Amorphous cobalt phyllosilicate (ACP)[3]	1.0	10	60	365
N-doped carbon sheets CoP (CoP/NCS)[1]	1.0	10	57	313
P and N co-doped carbon CoP (CoP@PNC)[4]	1.0	10	64	330
CoP nanoparticles (NPs)[5]	0.1	10	50	330
CoP_3 NAs/CFP[6]	1.0	10	62	334
Ni_79_P[7]	1.0	10	-	326
Sandwich-like CoP/C[8]	1.0	10	53	330
CoP nanorod[9]	1.0	10	71	320
CoP film[10]	1.0	10	47	345
p-CoP/$A_{l2}O_3$[11]	1.0	10	-	357
Co_3O_4 hollow polyhedrons[12]	1.0	10	61	536
Co_3O_4[13]	1.0	10	66	356
CoO/Co[14]	1.0	10	80	350
The Nitrogen doped graphene hollow microspheres supported CoO nanoparticles(CoO/NGHSs)[15]	1.0	10	70	330
CoO nanocrystals embedded into N-doped carbons(NC-CoO/C)[16]	1.0	10	45	362
Microspheric CoS_2 (MS CoS_2)[17]	1.0	10	92	325
$CoNi_2S4@CoS_2$/NF[18]	1.0	30	238	365
$CoS_{1.097}$ nanotubes[19]	1.0	10	-	330
Fe–NiNC-50[20]	1.0	10	54	340
Meso/micro-FeCo-Nx-CN-30[21]	1.0	10	57	440
FeCo-DACs/NC[22]	1.0	10	82.7	370
N-doped CoP@NC HNS (this work)	1.0	10	68	320

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