

Electronic Supplementary Information

Fabrication of hollow pompon-like Co₃O₄ nanostructure with rich defects and high-index facets exposure for enhanced oxygen evolution catalysis

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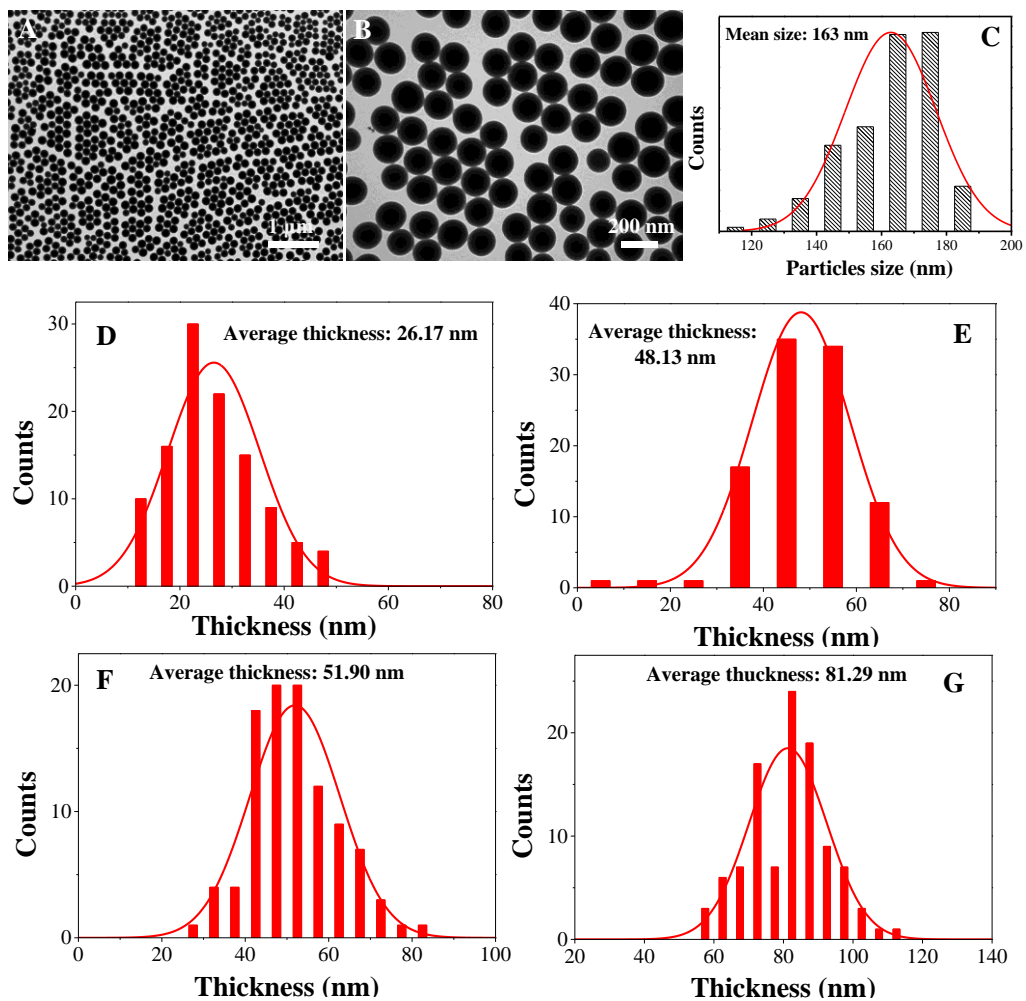


Fig. S1 TEM images of SiO₂ spheres at low (A) and high (B) magnifications; (C) Particle size distribution histogram of SiO₂ spheres. The distribution histograms of the average thickness of coating layer on SiO₂ spheres at different reaction times: (D) 4 h, (E) 8 h, (F) 12 h and (G) 24 h.

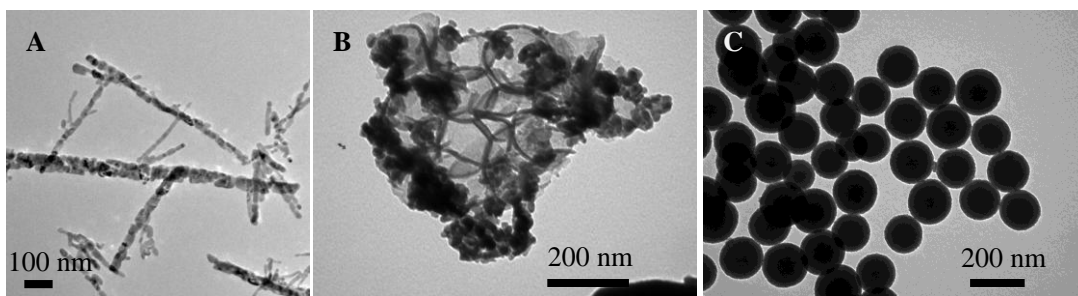


Fig. S2 TEM images of products obtained at 95 °C for 8 h (A) without adding SiO₂ sphere templates, (B) using NPHCSs as templates and (C) without adding urea.

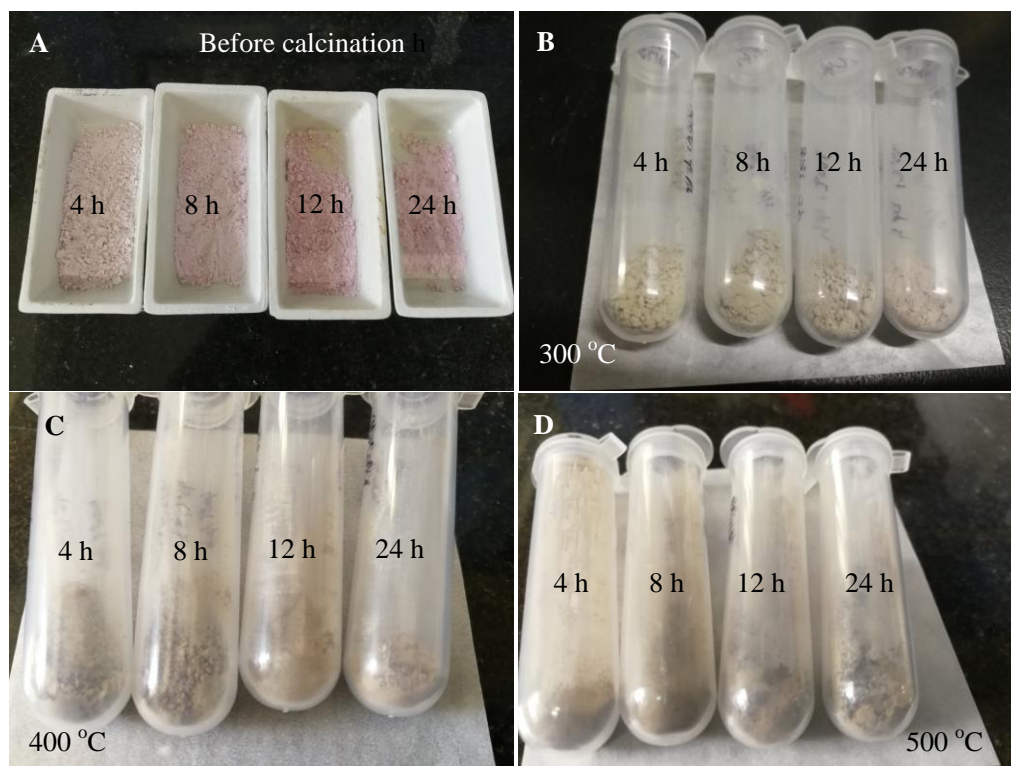


Fig. S3 Photographs of the samples prepared for different reaction times (4-24 h) taken before calcination (A) and after calcination at different temperatures (B) 300 °C, (C) 400 °C and (D) 500 °C.

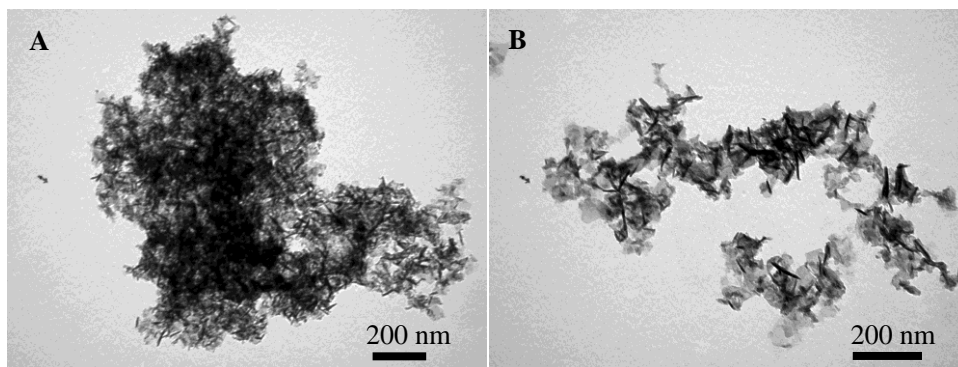


Fig. S4 TEM images of the products by removing SiO₂ templates at different temperatures: (A) 80 °C, (B) 50 °C.

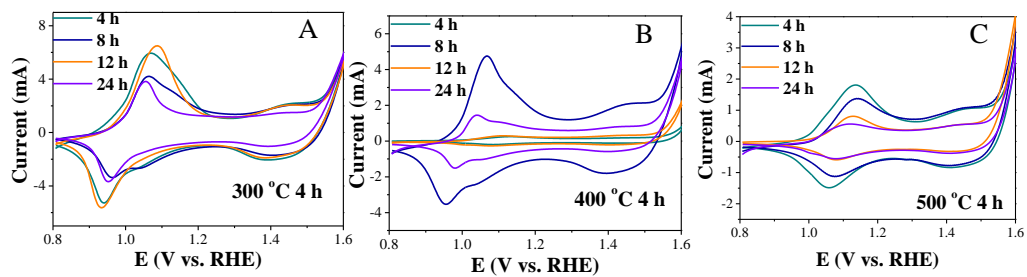


Fig. S5 CV curves of the Co_3O_4 HPNSs prepared at different calcination temperatures of (A) 300 °C, (B) 400 °C, and (C) 500 °C in N_2 -saturated 1 M KOH with potential scan rate of 50 mV s^{-1} .

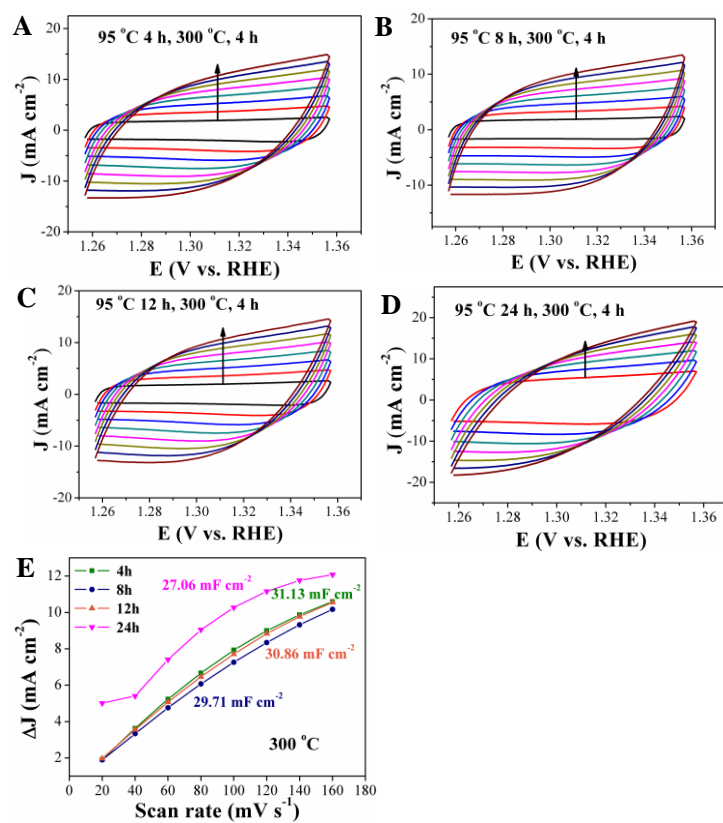


Fig. S6 CV curves of the Co_3O_4 HPNSs prepared with different reaction times: (A) 4 h, (B) 8 h, (C) 12 h and (D) 24 h after calcination at 300°C for 4 h at different scan rates from 20 to 160 mV s^{-1} , (E) The corresponding plots of current density at 1.31 V against scan rates for the four samples.

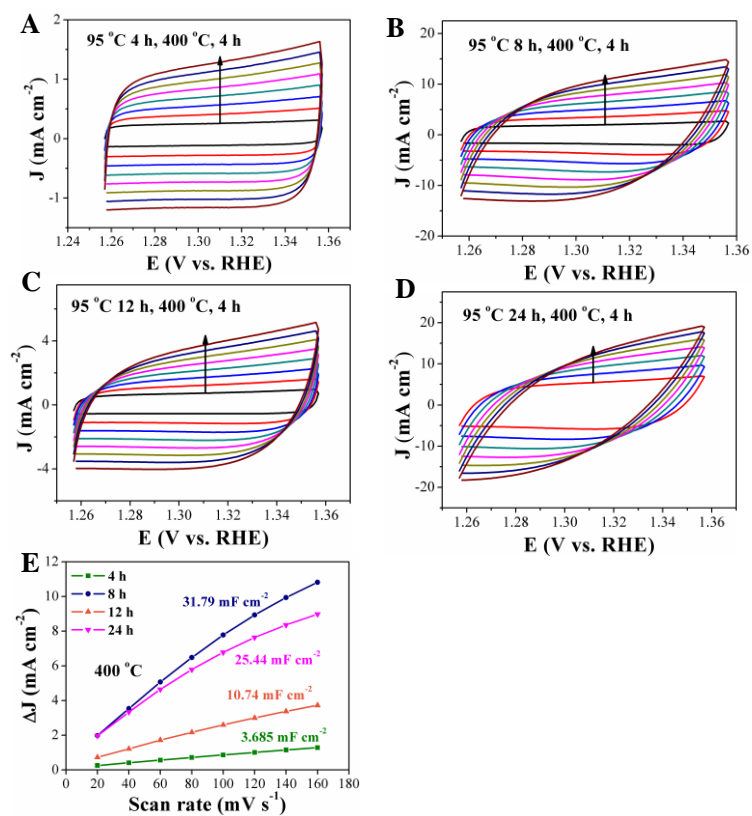


Fig. S7 CV curves of the Co_3O_4 HPNSs prepared with different reaction times: (A) 4 h, (B) 8 h, (C) 12 h and (D) 24 h after calcination at 400°C for 4 h at different scan rates from 20 to 160 mV s^{-1} , (E) The corresponding plots of current density at 1.31 V against scan rates for the four samples.

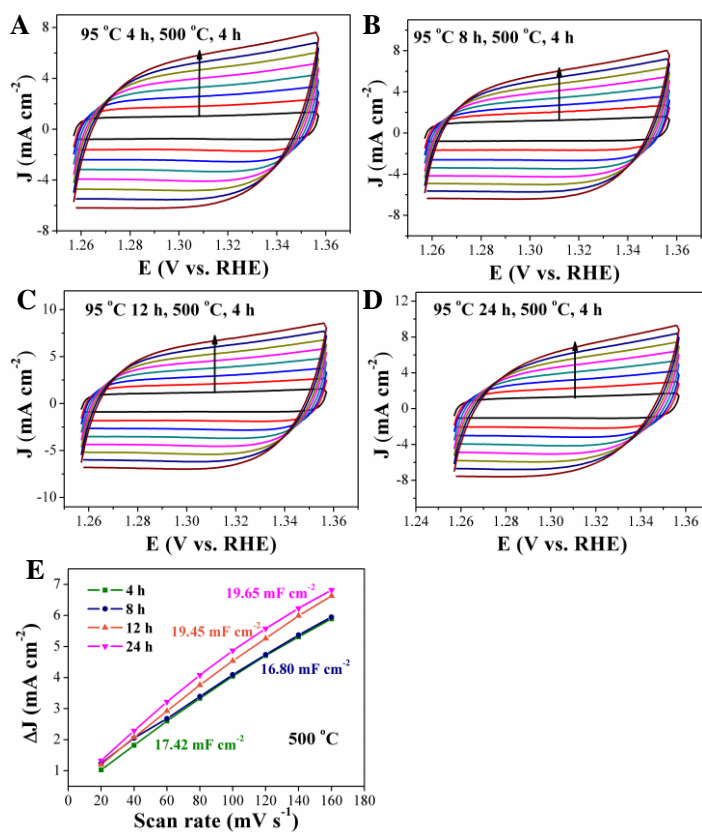


Fig. S8 CV curves of the Co_3O_4 HPNSs prepared with different reaction times: (A) 4 h, (B) 8 h, (C) 12 h and (D) 24 h after calcination at 500°C for 4 h at different scan rates from 20 to 160 mV s^{-1} , (E) The corresponding plots of current density at 1.31 V against scan rates for the four samples.

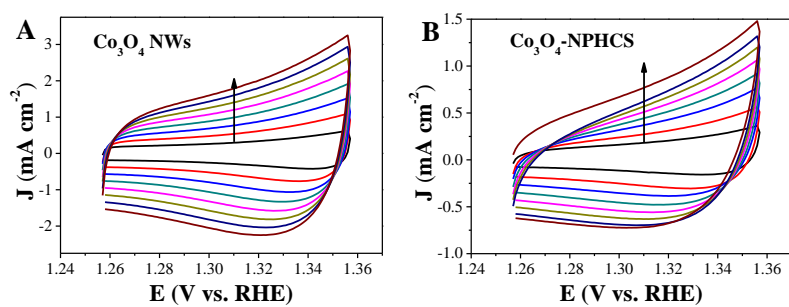


Fig. S9 CV curves of the Co_3O_4 NWs (A) and the Co_3O_4 -NPHCS (B) measured in a non-Faradaic region at different scan rates from 20 to 160 mV s^{-1} .

Table S1. Comparison of the OER activities of Co-based electrocatalysts in alkaline solution

Material	Current density (mA cm ⁻²)	Overpotential (mV)	Reference
Co ₃ O ₄ /CoMoO ₄ nanocages	10	318	1
	20	346	
	50	404	
Co ₃ O ₄ film	10	377	2
Hollow fluffy Co ₃ O ₄ cages-250	10	409	3
	20	431	
	50	467	
	100	500	
(112)faceted porous Co ₃ O ₄ nanosheets	10	318	4
Co ₃ O _{4-x} -carbon hollow polyhedrons	10	400	5
Ultrathin Co ₃ O ₄ nanomeshes	10	307	6
	100	407	
Co ₃ O ₄ -nitrogen doped hierarchically porous carbon	10	420	7
Reduced mesoporous Co ₃ O ₄ nanowires	13.1	420	8
Ni _{0.6} Co _{1.4} P	10	300	9
CoP		370	
CoPt@Co(OH) ₂	10	334	10
Co/N-doped graphene	10	340	11
Phosphorus-driven mesoporous Co ₃ O ₄ nanosheets	20	338	12
Iron-cobalt oxide nanosheets	10	308	13
Fe ₁ Co ₁ -ONSs			
Co@N-C materials:	10	350	14
C-MOF-C2-900		420	
C-MOF-C2-800		500	
C-MOF-C2-1000			
CoO _x nanoparticles rich in oxygen vacancies grown on B,N-decorated graphene(CoO _x NPs/BNG)	10	295	15
P-Co ₃ O ₄	10	280	16
V ₆ -Co ₃ O ₄		330	
Co(OH) ₂ @N-doped carbon nanotubes@nickel foam	10	270	17
	100	410	
Co ₃ O ₄ NWs	10	370	This work
	20	404	
	50	435	
	100	468	
Co ₃ O ₄ -NPHCS	10	370	This work
	20	400	
	50	439	
	100	504	
Co ₃ O ₄ HPNSs-400	10	308	This work
	20	320	
	50	348	
	100	370	

Table S2 BET surface areas and pore sizes of various Co₃O₄ materials.

Material	BET surface area (m ² g ⁻¹)	Reference
Co ₃ O ₄ nanocube	24.67	
Co ₃ O ₄ nanobelt	21.53	18
Co ₃ O ₄ nanooctahedron	30.34	
Co ₃ O ₄ nanosheet	51.94	
Co ₃ O ₄ -carbon porous nanowires arrays	251	19
Uncalcined Co ₃ O ₄ spheres	125.5	
Double-shelled Co ₃ O ₄ hollow spheres	40.1	
Triple-shelled Co ₃ O ₄ hollow spheres	77.6	20
Quadruple-shelled Co ₃ O ₄ hollow spheres	10.4	
Quintuple-shelled Co ₃ O ₄ hollow spheres	81.6	
Co ₃ O ₄ nanocubes	24.2	
Pseudo octahedral Co ₃ O ₄	23.6	
(110) facets exposed nanosheets	18.5	21
(111) facets exposed hexagonal nanoplates	79.3	
(112) facets exposed nanolaminars	214.7	
Co ₃ O ₄ ultrathin nanosheet arrays	158.85	22
Co ₃ O ₄ microflowers	61.37 (cm ² g ⁻¹)	23
Reduced Co ₃ O ₄ nanowires	54	8
Co ₃ O ₄ nanosheets	100.42	24
Ultrathin Co ₃ O ₄ nanomeshes	208.64	6
Cubic Co ₃ O ₄ -18 nm	70	
Cubic Co ₃ O ₄ -9 nm	150	25
Triangular Co ₃ O ₄ -9 nm		
Reduced Co ₃ O ₄	29.15	26
Pristine Co ₃ O ₄	21.37	
Co ₃ O ₄ /N-doped hollow carbon spheres	232	27
Co ₃ O ₄ NWs	28.78	This work
Co ₃ O ₄ HPNS-400	233.5	This work

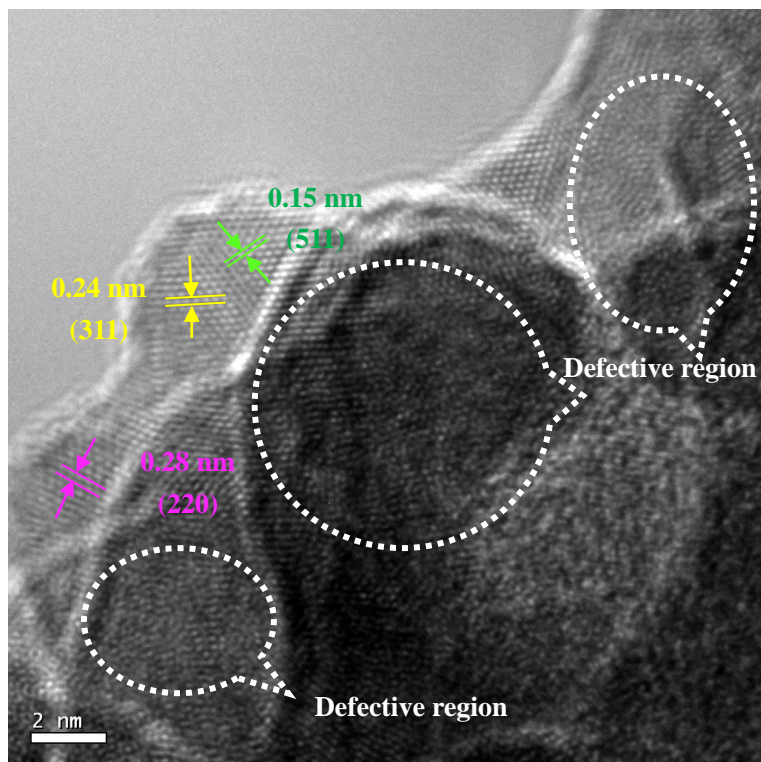


Fig. S10 HRTEM image of the short burrs on the surface of Co₃O₄ HPNS-400.

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