Supporting Information

In-situ synthesis of highly dispersed Co-N-C catalysts with carbon-coated sandwich structure based on defect anchoring

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1. Experimental

1.1 Catalyst Characterization

Nitrogen adsorption-desorption isotherms were measured on Nova 1000e apparatus from Quanta Chrome Instruments at 77 K. The samples were outgassed at 200 ℃ for 3 h prior to the measurements. In the relative pressure ranging from 0.05 to 0.98, the specific surface areas (S_{BET}), the mesoporous volume (V_{tot}) and pore size (D_P) distribution were calculated using the Brunauer-Emmett-Teller (BET) and the Barrett-Joyner-Halenda (BJH) formula. Raman was conducted on Mono Vista 2560 Spectrometer with a 532 nm (2.33 eV) laser. High-resolution transmission electron microscope (HRTEM, JEOL-2100F) operating at 200 kV was carried to measure the morphology of samples. The mapping was conducted to determine the local elemental composition. X-ray photoelectron spectroscopy (XPS) was measured on a PHI 5000 CESCA system (Perkin Elmer) using Al Kα radiation (1486.6 eV). The X-ray diffraction (XRD) analysis was performed on a Japan XRD-6100 analyzer using Ni-filtered Cu Kα radiation with a scanning angle (2θ) ranging from 10^o-80^o, operated at 50 kV and 10 mA.

2. Characterization and results

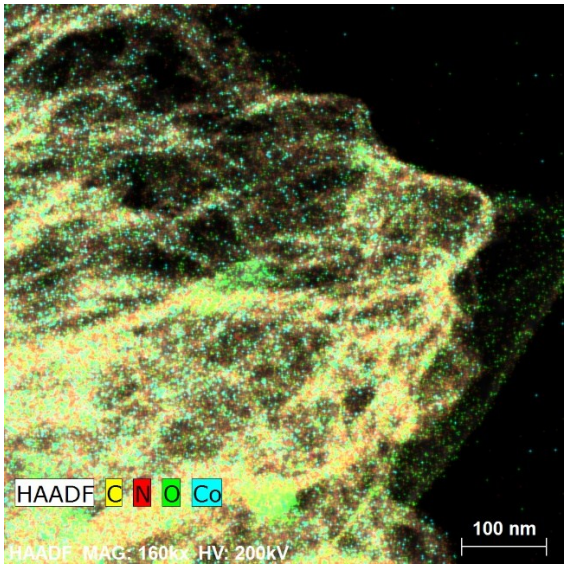

Fig. S1. HAADF-STEM image of Co-N-C-20.

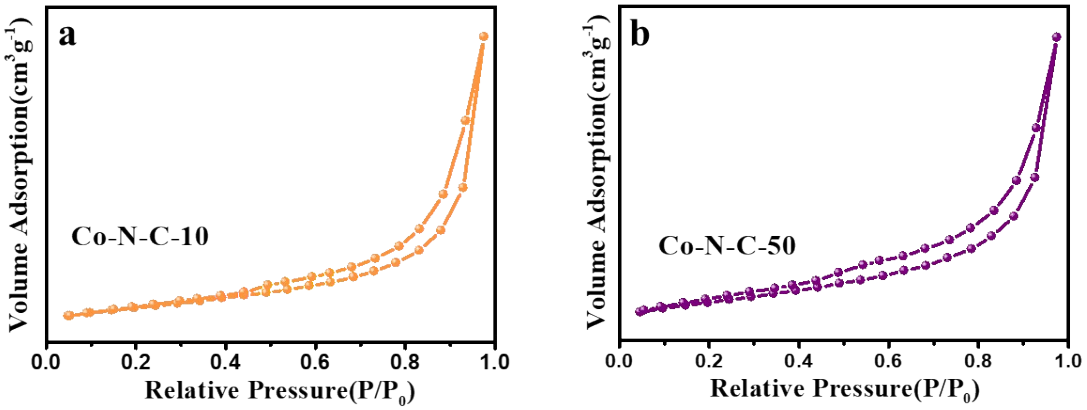

Fig. S2. Nitrogen adsorption–desorption isotherms of Co-N-C-10 and Co-N-C-50.

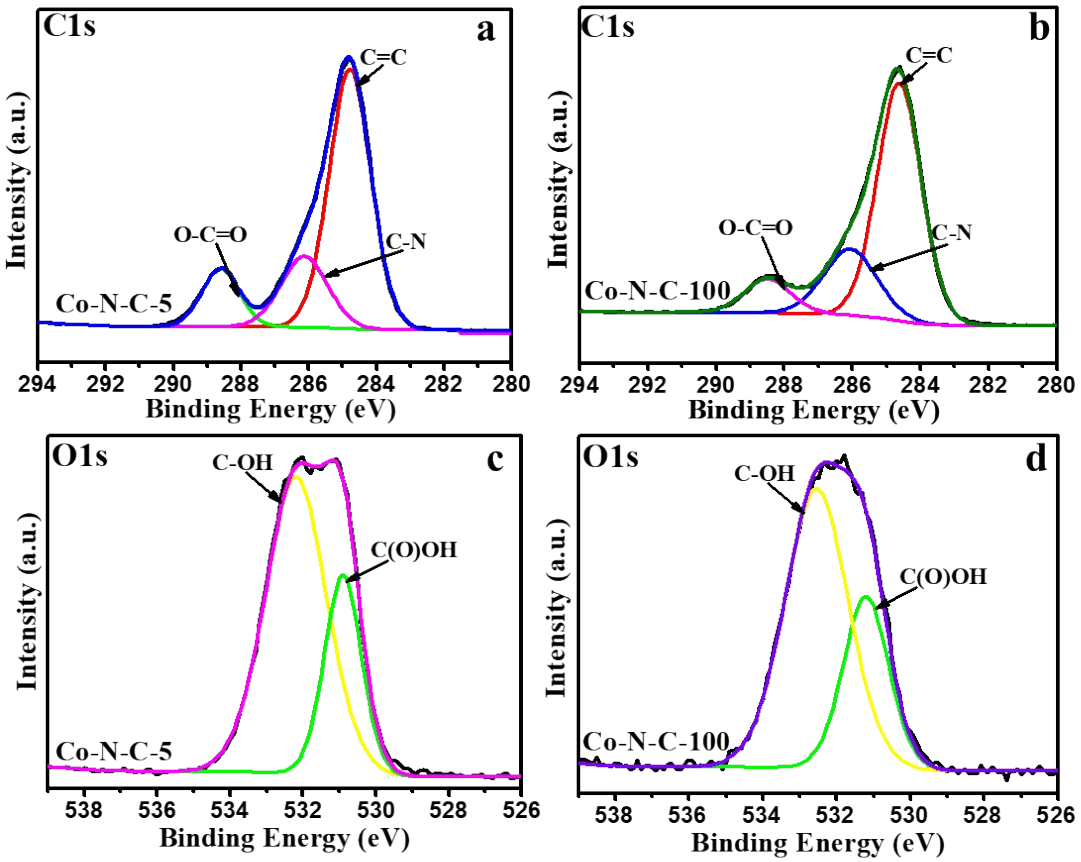

Fig. S3. XPS spectra of as-prepared catalysts. (a) C 1s XPS spectrum and (c) O 1s XPS spectrum of the sample Co-N-C-5; (b) C 1s XPS spectrum and (d) O 1s XPS spectrum of the sample Co-N-C-100.

Table S1 Quantitative XPS analysis for Co-N-C-100, Co-N-C-20 and Co-N-C-5.

Catalyst	C(at%)	O(at%)	N(at%)					Co(at%)	Co2p3/2(at%)	
			Total	Pyridinic N	Pyrrolic N	Graphitic N	N- oxides		Co-O	Co-N
Co-N-C-100	76.17	13.97	8.92	40.32	18.55	34.68	6.45	0.94	91.74	8.26
Co-N-C-20	73.56	10.81	14.90	49.26	6.90	37.44	6.40	0.73	86.21	13.79
Co-N-C-5	75.95	20.96	2.49	25.37	36.76	34.56	3.31	0.60	93.46	6.54