Structural design of FeCo alloy implanted into N, S co-doped carbon nanotubes via self-catalyzed growth for advanced liquid and flexible all-state-state Zn-air battery

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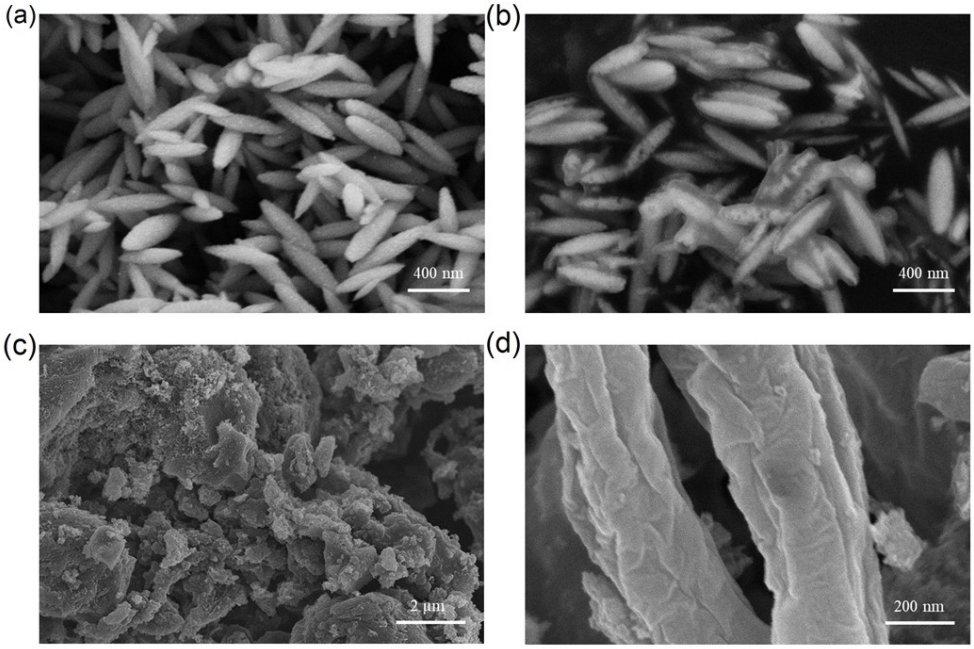

Fig. S1 SEM images of (a) Fe_2O_3, (b) Fe_2O_3/Co@C, (c) Co-NSC and (d) Fe-NSCNTs.

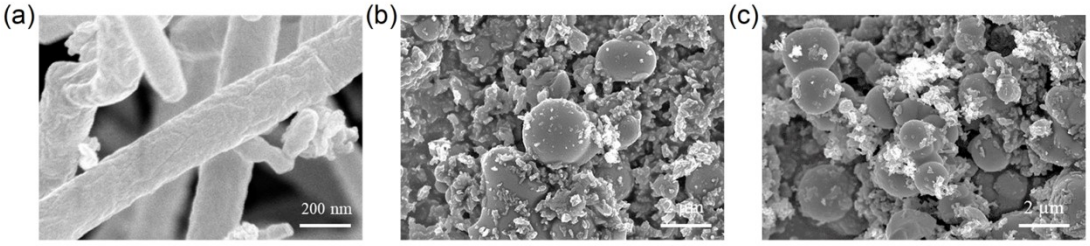

Fig. S2 SEM images of (a) FeCo-NCNTs, (b) FeCo-SC, (c) FeCo-C.

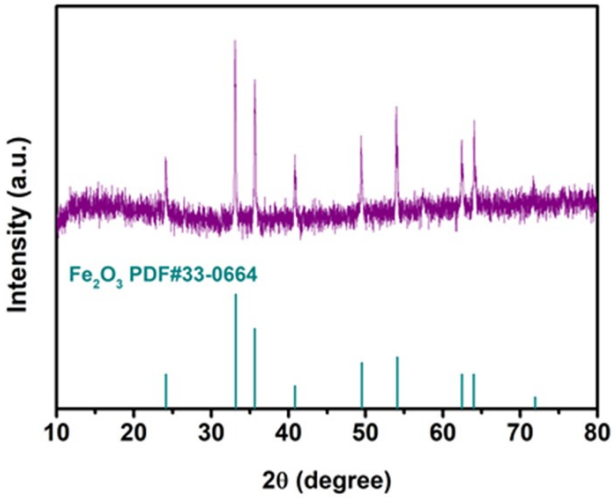

Fig. S3 XRD patterns of Fe_2O_3.

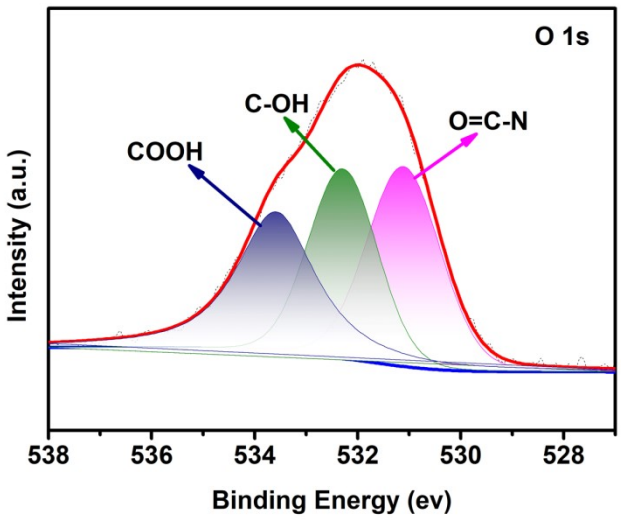

Fig. S4 O 1s spectra of $FeCo_{10}$-NSCNTs.

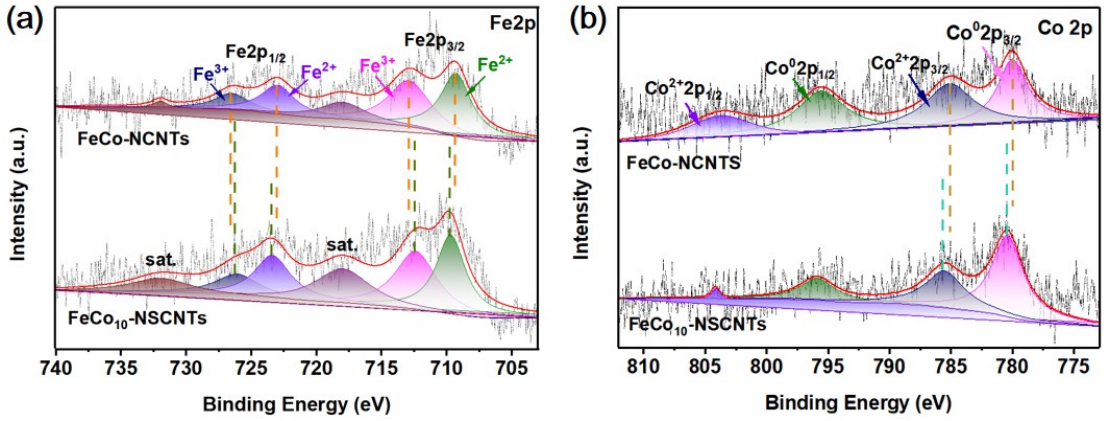

Fig. S5 (a) Fe 2p of FeCo-NCNTs and $FeCo_{10}$-NSCNTs, (b) Co 2p of FeCo-NCNTs and $FeCo_{10}$-NSCNTs.

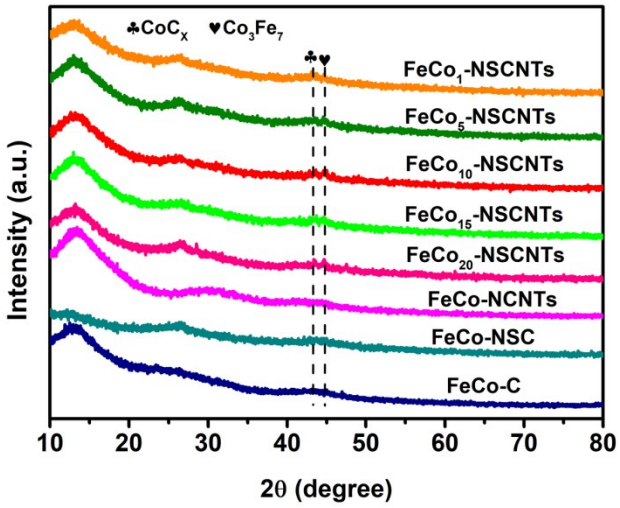

Fig. S6 XRD patterns of $FeCo_1$-NSCNTs, $FeCo_5$-NSCNTs, $FeCo_{10}$-NSCNTs, $FeCo_{15}$-NSCNTs, $FeCo_{20}$-NSCNTs, FeCo-NCNTs, FeCo-SC and FeCo-C.

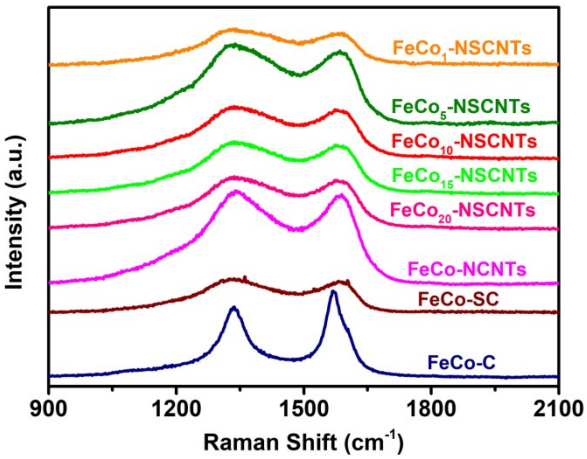

Fig. S7 Raman spectra of $FeCo_1$-NSCNTs, $FeCo_5$-NSCNTs, $FeCo_{10}$-NSCNTs, $FeCo_{15}$-NSCNTs, $FeCo_{20}$-NSCNTs, FeCo-NCNTs, FeCo-SC and FeCo-C.

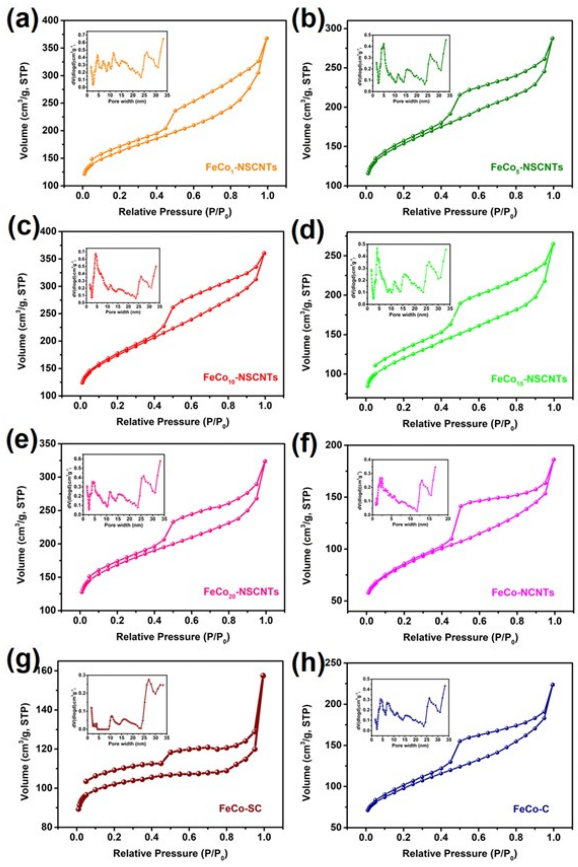

Fig. S8 Nitrogen gas adsorption-desorption isotherms (the insert is pore-size distribution) of (a) $FeCo_1$-NSCNTs, (b) $FeCo_5$-NSCNTs, (c) $FeCo_{10}$-NSCNTs, (d) $FeCo_{15}$-NSCNTs, (e) $FeCo_{20}$-NSCNTs, (f) FeCo-NCNTs, (g) FeCo-SC and (h) FeCo-C.

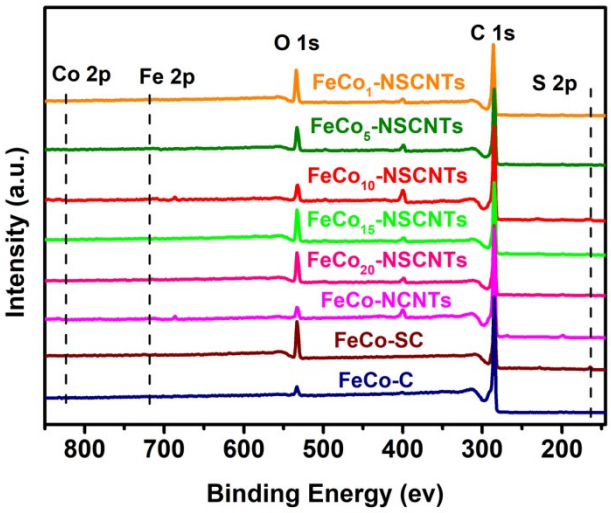

Fig. S9 XPS spectra of $FeCo_1$-NSCNTs, $FeCo_5$-NSCNTs, $FeCo_{10}$-NSCNTs, $FeCo_{15}$-NSCNTs, $FeCo_{20}$-NSCNTs, FeCo-NCNTs, FeCo-SC and FeCo-C.

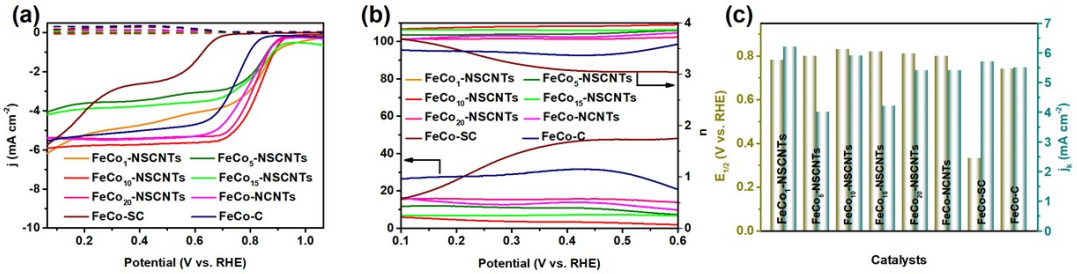

Fig. S10 Electrocatalytic behavior in 0.1 M KOH: (a) LSV curves at a rotating speed of 1600 rpm at 10 mV s^{-1}, (b) H_2O_2 yields and n, (c) comparison $E_{1/2}$ and j_k of $FeCo_1$-NSCNTs, $FeCo_5$-NSCNTs, $FeCo_{10}$-NSCNTs, $FeCo_{15}$-NSCNTs, $FeCo_{20}$-NSCNTs, FeCo-NCNTs, FeCo-SC and FeCo-C.

Table S1 The intensity ratios of the D band and G band, specific surface area, j_k and $E_{1/2}$ of $FeCo_1$-NSCNTs, $FeCo_5$-NSCNTs, $FeCo_{10}$-NSCNTs, $FeCo_{15}$-NSCNTs, $FeCo_{20}$-NSCNTs, FeCo-NCNTs, FeCo-SC and FeCo-C.

Sample	I_D/I_G	S_{BET} ($m^2\ g^{-1}$)	j_k ($mA\ cm^{-2}$)	$E_{1/2}$ (V)
$FeCo_1$-NSCNTs	1.31	531.27	6.18	0.78
$FeCo_5$-NSCNTs	1.26	489.03	4.11	0.80
$FeCo_{10}$-NSCNTs	1.23	574.42	5.90	0.83
$FeCo_{15}$-NSCNTs	1.31	409.92	4.23	0.82
$FeCo_{20}$-NSCNTs	1.23	546.85	5.40	0.81
FeCo-NCNTs	1.15	283.22	5.38	0.80
FeCo-SCNTs	1.21	328.70	5.71	0.33
Fe/Co-C	0.78	336.51	5.46	0.74

Table S2 The elemental contents of $FeCo_1$-NSCNTs, $FeCo_5$-NSCNTs, $FeCo_{10}$-NSCNTs, $FeCo_{15}$-NSCNTs, $FeCo_{20}$-NSCNTs, FeCo-NCNTs, FeCo-SC and FeCo-C.

Sample	C (at%)	N (at%)	O (at%)	S (at%)	Fe (at%)	Co (at%)
Fe/Co_1-NSCNTs	79.60	4.05	15.01	0.71	0.35	0.28
Fe/Co_5-NSCNTs	81.35	6.28	11.06	0.59	0.41	0.31
Fe/Co_{10}-NSCNTs	81.69	9.63	6.52	1.45	0.47	0.24
Fe/Co_{15}-NSCNTs	78.43	4.53	15.37	1.07	0.34	0.26
Fe/Co_{20}-NSCNTs	79.38	4.90	14.36	0.79	0.38	0.29
Fe/Co-NCNTs	88.09	6.47	4.88	---	0.39	0.18
Fe/Co-SCNTs	79.54	---	18.00	1.74	0.41	0.31
Fe/Co-C	96.10	---	3.90	---	---	---