Electronic Supplementary Information

CNT@Ni@Ni-Co silicate core-shell nanocomposite: a synergistic triple-coaxial catalyst for enhancing catalytic activity and controlling side products for Li-O_2 batteries

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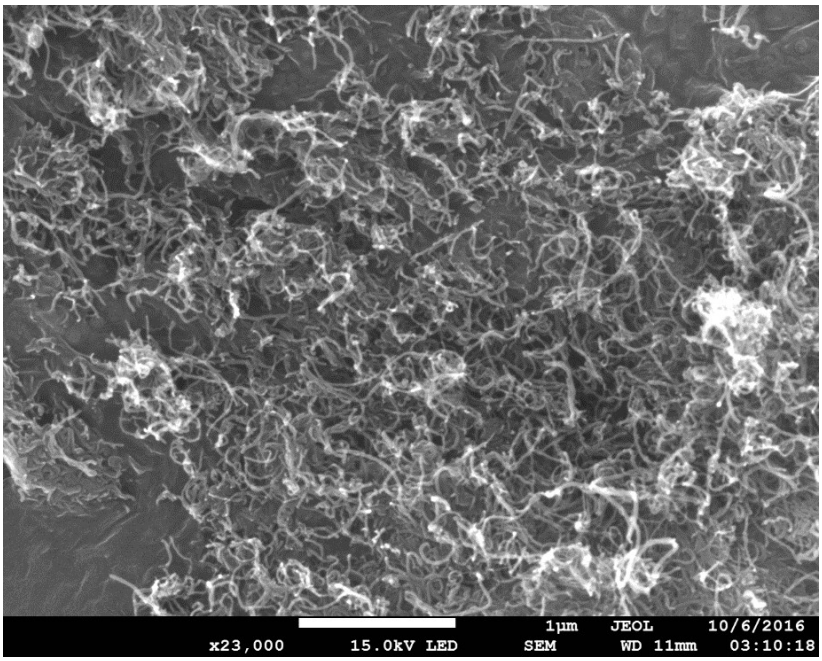

Fig. S1 SEM image of CNTs

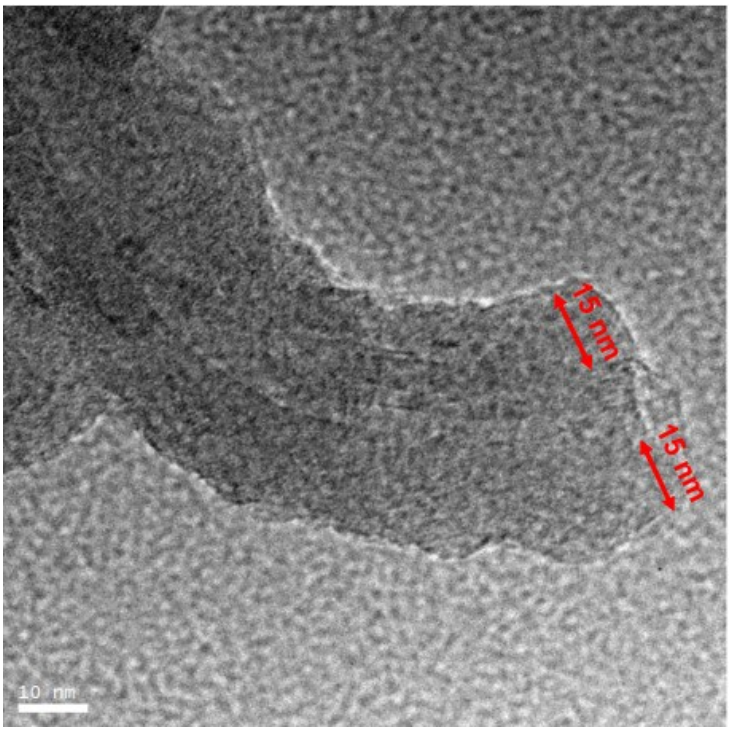

Fig. S2 TEM image of CNT@SiO_2

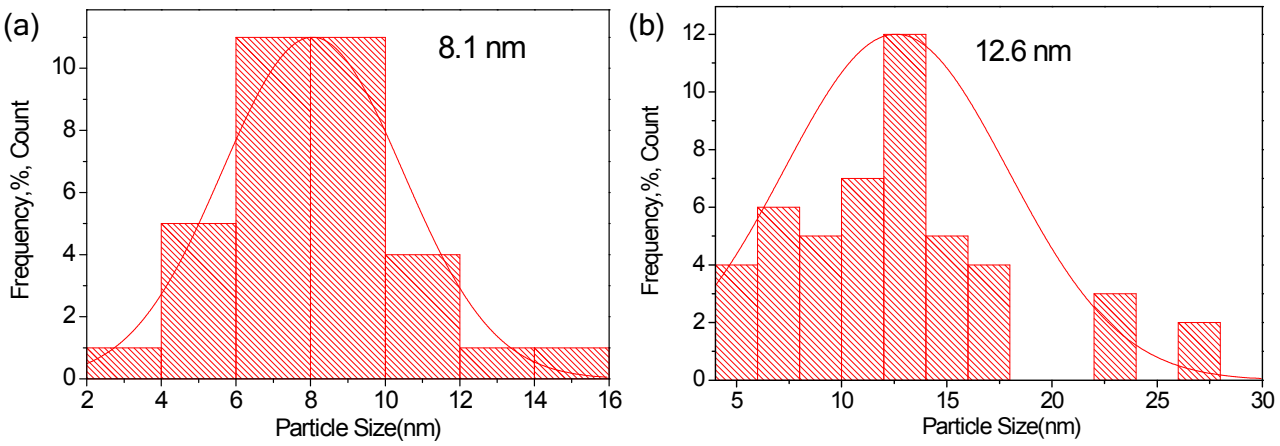

Fig. S3 Particle size distribution of Ni nanoaprticles in (a) CNT@Ni@NiCo silicate and (b) Ni/CNT.

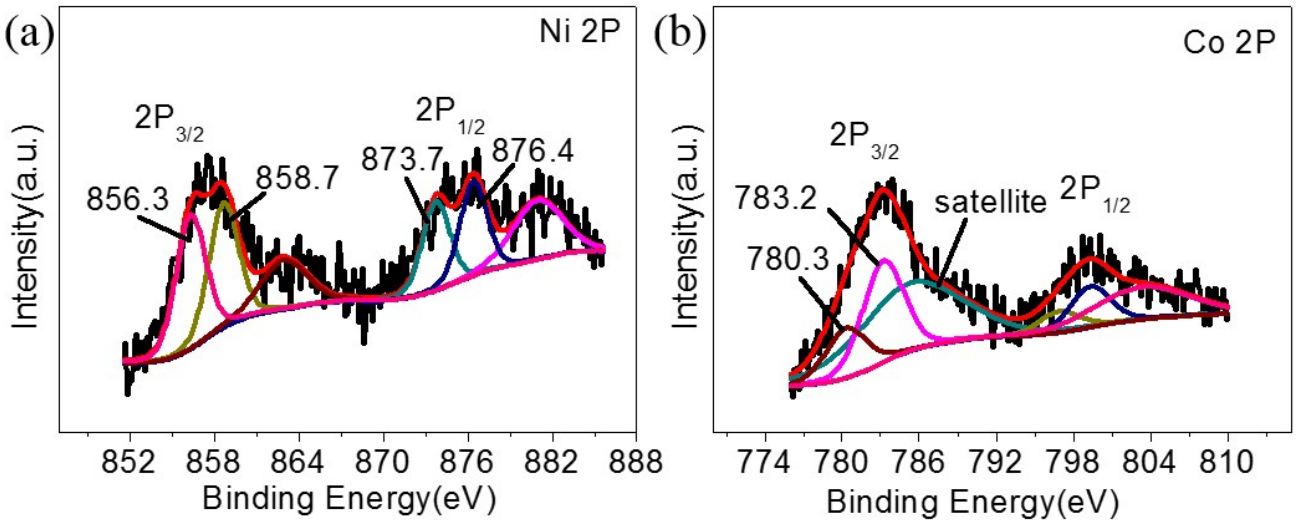

Fig. S4 XPS spectra of CNT@NiCo silicate.

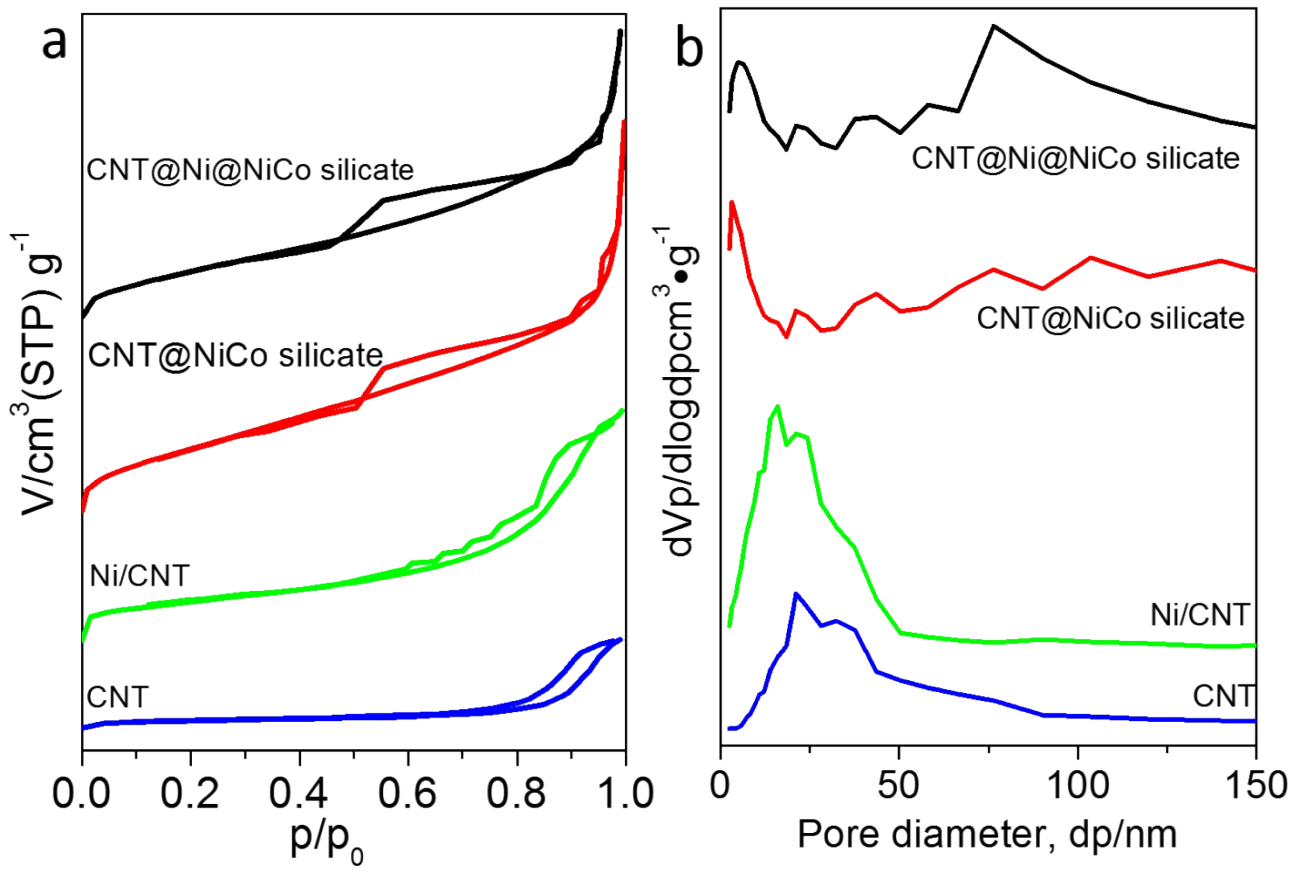

Fig. S5 (a) N_2 adsorption–desorption isotherms and (b) pore size distribution for different catalysts.

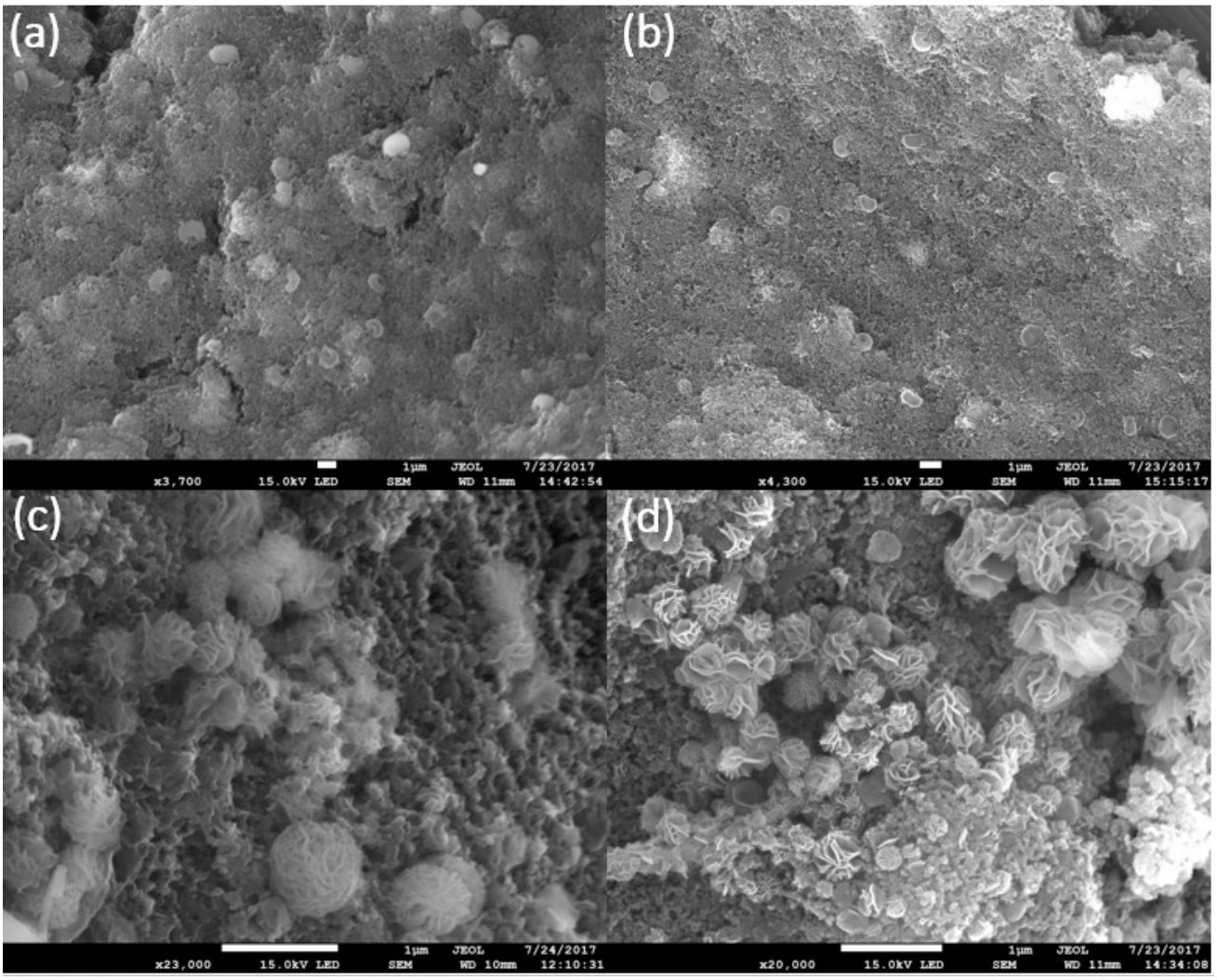

Fig. S6 SEM images of different electrodes after discharge at a current density of 150 $mA \cdot gcat^{-1}$ with a capacity limitation of 1000 $mAh \cdot gcat^{-1}$: (a) CNT, (b) Ni/CNT, (c) CNT@NiCo silicate and (d) CNT@Ni@NiCo silicate.

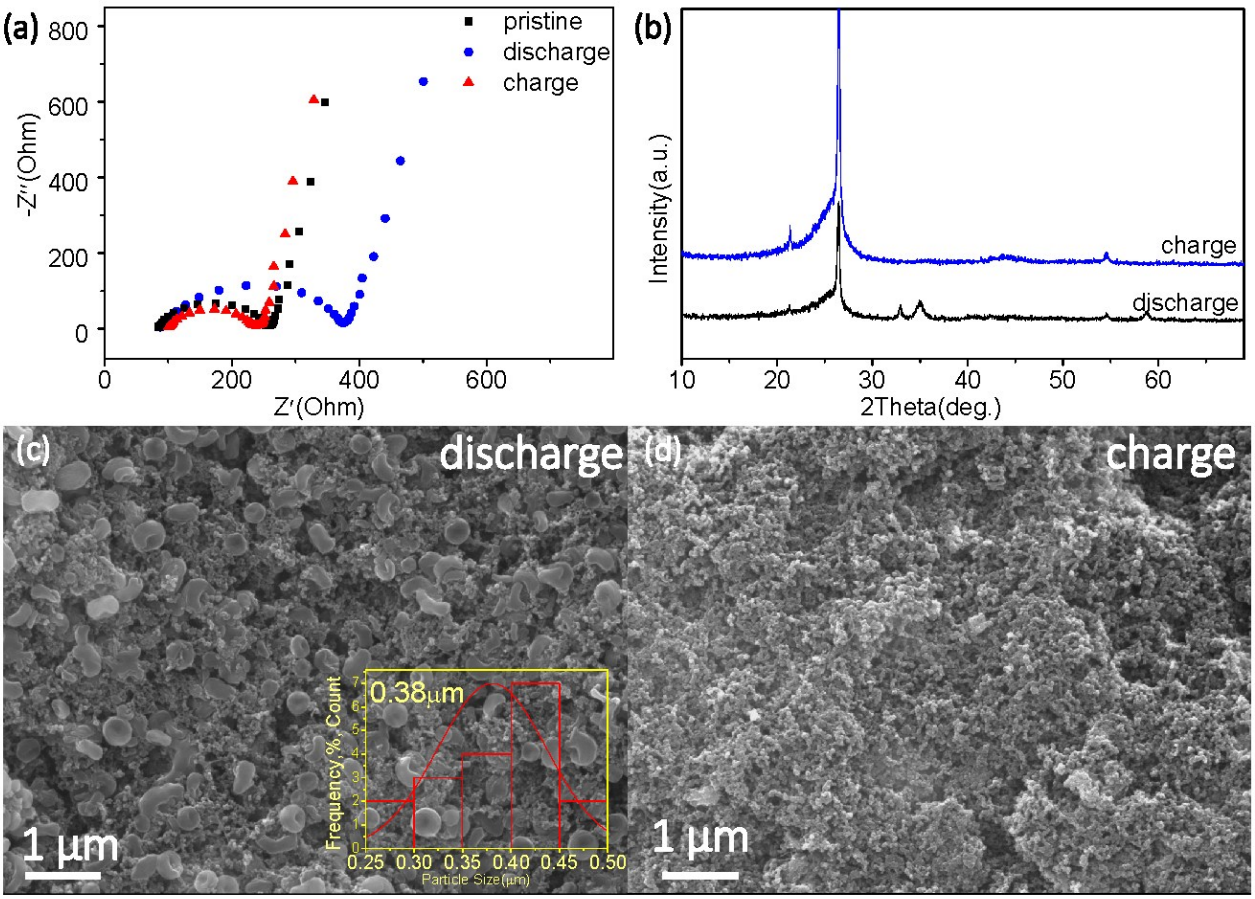

Fig. S7 (a) Nyquist plots, (b) XRD patterns and (c-d) SEM images of CNT@NiCo silicate electrode at different discharge/charge stages at 200 mA·gcat^{-1}.

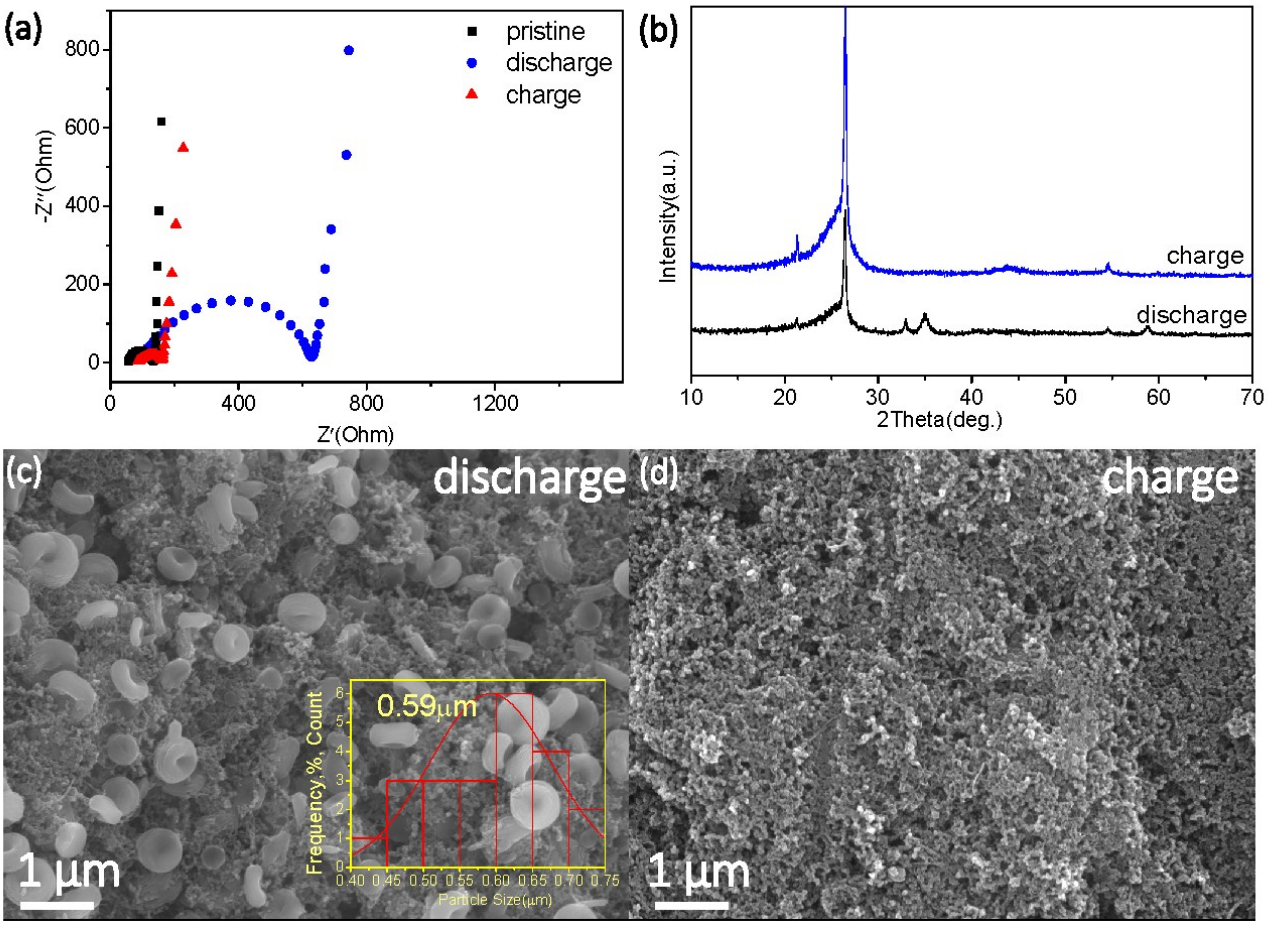

Fig. S8 (a) Nyquist plots, (b) XRD patterns and (c-d) SEM images of CNT electrode at different discharge/charge stages at 200 mA·gcat^{-1}.

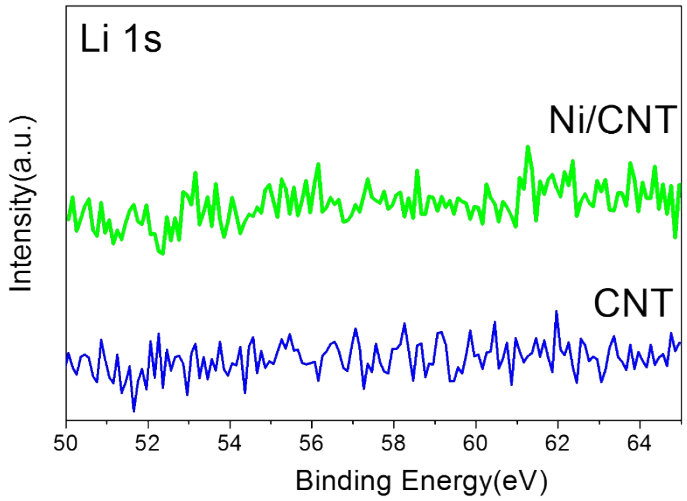

Fig. S9 Li 1s XPS spectra of CNT and Ni/CNT electrodes after 1st charge.

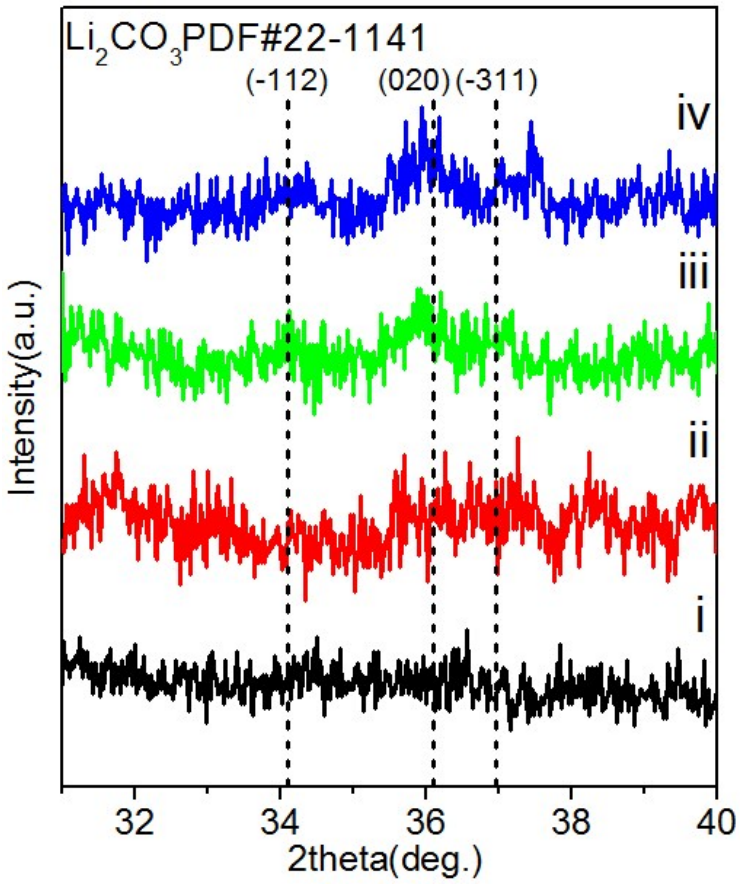

Fig. S10 XRD patterns of different electrodes ((i) CNT@Ni@NiCo silicate, (ii) CNT@NiCo silicate, (iii) Ni/CNT and (iv) CNT) after 14 cycles.

Table S1 XPS peak deconvolution results and peak parameters of CNT@Ni@NiCo silicate and CNT@NiCo silicate catalysts

	CNT@Ni@NiCo silicate			CNT@NiCo silicate		
	B.E./eV	FWHM/eV	Peak area	B.E. /eV	FWHM/eV	Peak area
Ni 2p 3/2	852.3	2.7	414.39	856.3	2.5	1290.98
	856.3	2.5	1870.89	858.7	2.5	1200.05
Ni 2p 1/2	871.0	2.5	159.53	873.7	2.3	792.96
	874.3	2.5	982.68	876.4	2.3	832.55
Co 2p 3/2	781.4	3.6	3040.09	780.3	3.8	936.51
				783.2	3.8	1908.68
Co 2p 1/2	797.6	3.6	1557.01	796.9	3.8	403.56
				799.3	3.8	767.96

Table S2 Physical properties of catalysts

Physical properties / Samples	Specific surface area BET($m^2 \cdot g^{-1}$)	Total pore volume($cm^3 \cdot g^{-1}$)	BJH mean pore diameter(nm)
CNT	25.05	0.126	20.1
Ni/CNT	128.17	0.321	10.0
CNT@NiCo silicate	301.91	0.483	6.4
CNT@Ni@NiCo silicate	207.19	0.410	7.9

Table S3 Potentials at different discharge and charge stages with and without the 1000 $mAhgcat^{-1}$ capacity limitation for different catalyst samples

potential / sample	1st fully discharge-charge between 2-4.5 V			1st discharge-charge between 2-4.5 V cut-off at 1000 $mAhgcat^{-1}$		
	Half fully discharge	Half fully charge	Over-potential	Discharge at 500 $mAhgcat^{-1}$	Charge at 500 $mAhgcat^{-1}$	Over-potential
CNT	2.60	4.16	1.56	2.69	4.19	1.50
Ni/CNT	2.64	4.13	1.49	2.70	3.99	1.29
CNT@NiCo silicate	2.67	4.12	1.45	2.72	3.96	1.24
CNT@Ni@NiCo silicate	2.67	4.11	1.44	2.72	3.94	1.22

Table S4 Peak area of XPS spectra for CNT@Ni@NiCo silicate electrodes after different cycles

area / cycle	Li_2O_2	Li_2CO_3	side products	Li_2CO_3 and side products Ratio(%)
1	-	-	52.07	-
14	68.00	75.50	58.50	66.3
43	49.10	152.45	132.24	85.3

Table S5 Peak area of Li 1s XPS spectra for different electrodes after 14 cycles

area / sample	Li_2O_2	Li_2CO_3	side products	Li_2CO_3 and side products Ratio (%)
CNT	28.50	241.05	116.59	92.6
Ni/CNT	64.87	144.03	99.34	78.9
CNT@NiCo silicate	40.13	87.77	40.81	76.2
CNT@Ni@NiCo silicate	68.00	75.50	58.50	66.3

Table S6 Peak area of C 1s XPS spectra for different electrodes after 14 cycles

area / sample	C=O	C-O	C-C	C=O Ratio(%)
CNT	9556.024	18888.68	28814.92	16.7
Ni/CNT	3534.734	15973.35	29460.73	7.2
CNT@NiCo silicate	4165.878	17441.33	46073.95	6.2
CNT@Ni@NiCo silicate	2120.02	10983.74	27178.61	5.3