Electronic Supplementary Information

A Unique Hierarchical Structure: $NiCo_2O_4$ Nanowire Decorated NiO Nanosheets as a Carbon-Free Cathode for Li-O_2 Battery

Table of Contents

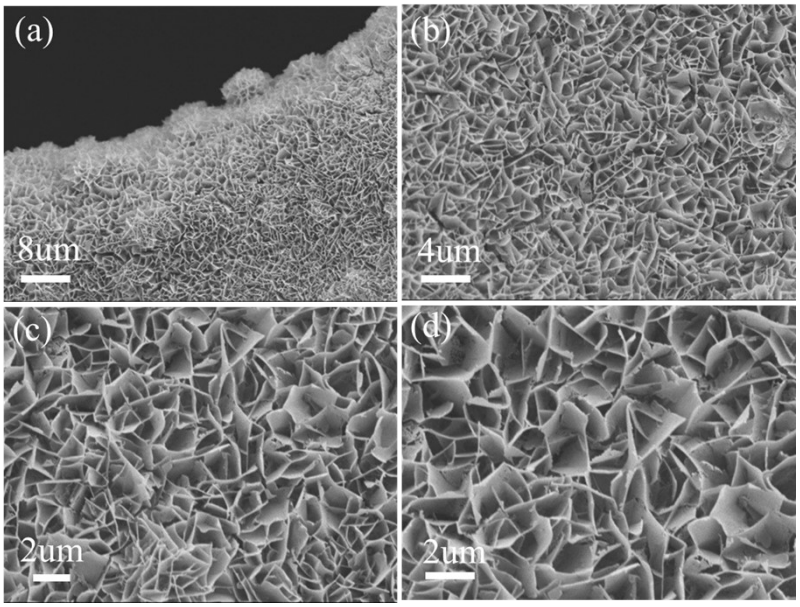

Fig. S1 FESEM images of NiO (a, b, c, d) on Ni foam with different magnifications.

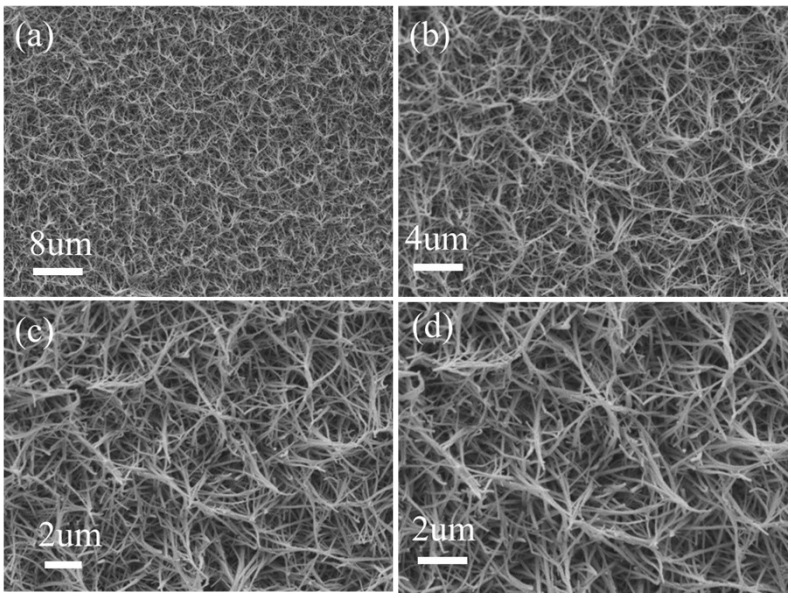

Fig. S2 FESEM images of $NiCo_2O_4$ (a, b, c, d) on Ni foam with different magnifications.

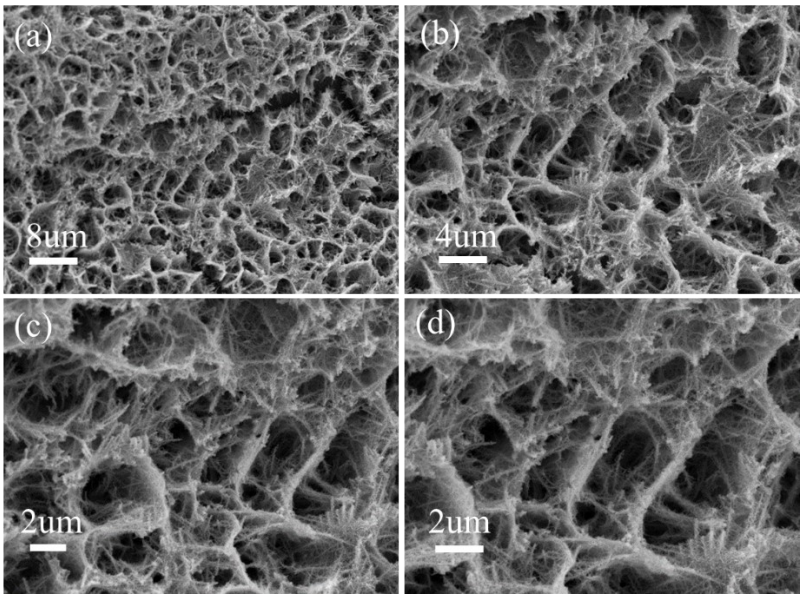

Fig. S3 FESEM images of $NiO@NiCo_2O_4$ (a, b, c, d) on Ni foam with different magnifications.

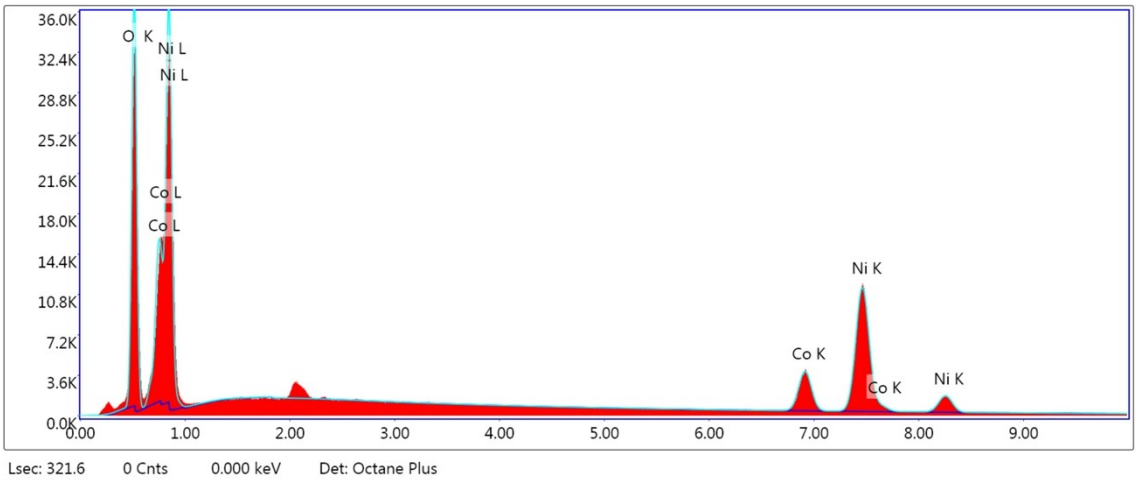

Fig. S4 EDX spectrum of the $NiO@NiCo_2O_4$ on Ni foam.

Table S1 EDX analysis of $NiO@NiCo_2O_4$ on Ni foam.

Elements	$NiO@NiCo_2O_4$ (wt%)
O	18.8
Co	15.55
Ni	65.65
Total	100

Table S2 Comparison of the specific surface area, pore volume and BJH pore size of three types of NiO, $NiCo_2O_4$ and NiO@$NiCo_2O_4$.

Material	Surface area (m^2/g)	Pore volume(cm^3/g)	BJH Pore size (nm)
NiO	6.96	$3.32*10^{-2}$	5.79
$NiCo_2O_4$	3.13	$1.82*10^{-2}$	9.53
NiO@$NiCo_2O_4$	19.40	$2.56*10^{-2}$	2.52

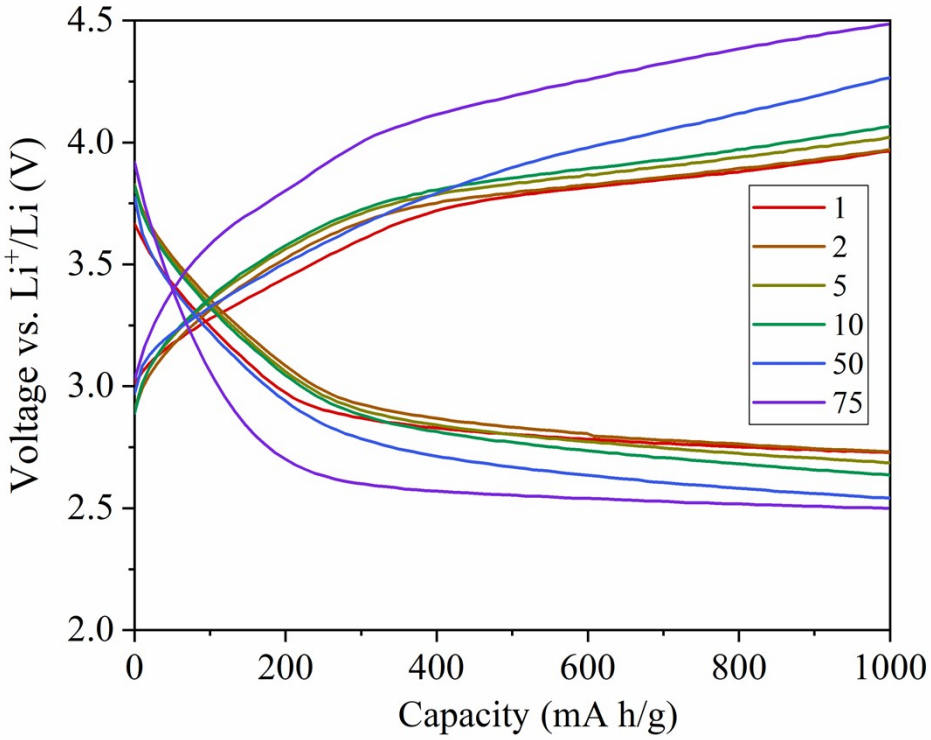

Fig S5 The discharge-charge curves of NiO@$NiCo_2O_4$-based electrodes with a fixed capacity of 1000 mA h g^{-1} at a current density of 200 mA g^{-1}.

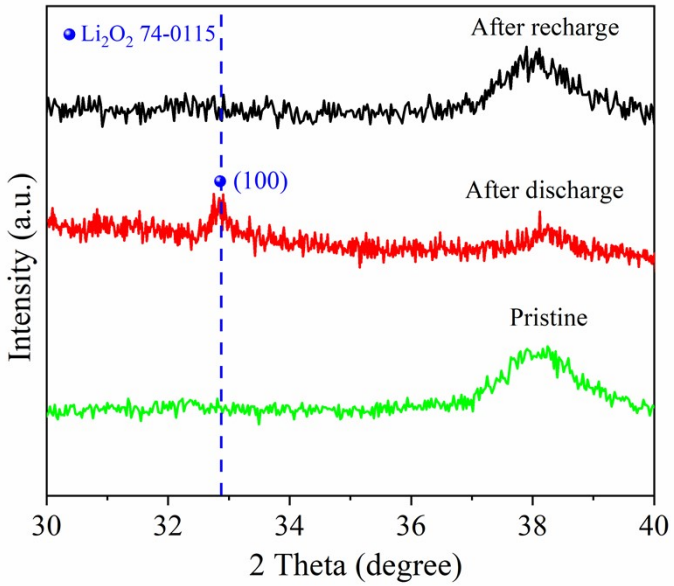

Fig. S6 XRD patterns of NiO@$NiCo_2O_4$-based electrodes at the pristine time, after discharge and after recharge process. (Current density: 200 mA g^{-1})

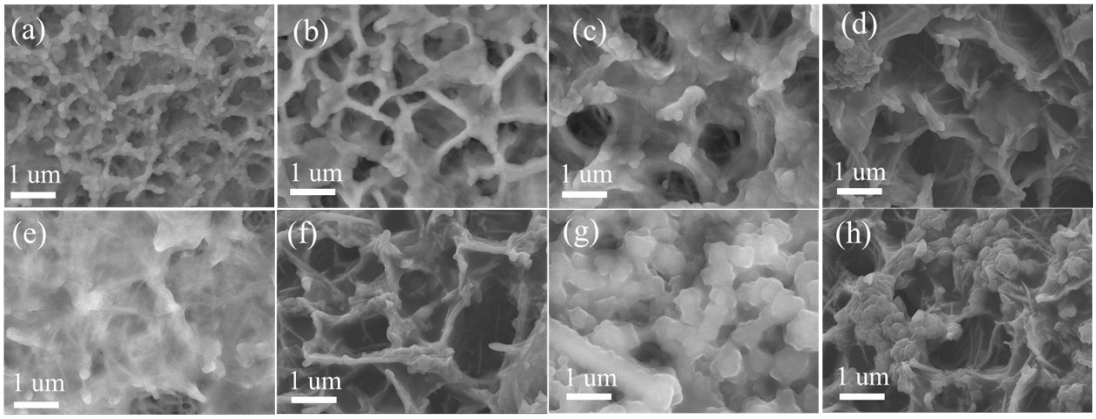

Fig. S7 FESEM images of NiO@$NiCo_2O_4$ electrodes at (a) the 1st cycle discharged, (b) the 1st cycle charged, (c) the 50th cycle discharged (d) the 50th cycle recharged € the 100th cycle discharged, (f) the 100th cycle recharged, (g) the 176th cycle discharged and (h) the 176th cycle recharged stages.

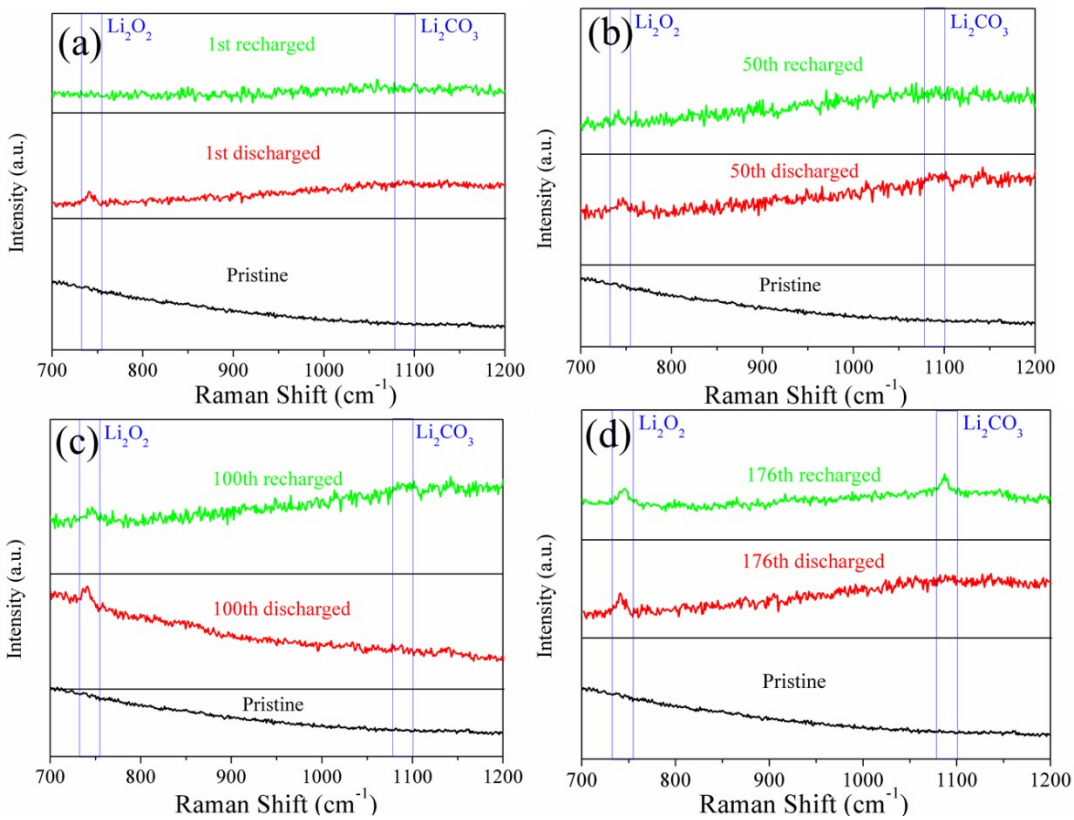

Fig. S8 Raman patterns of discharged/charged NiO@$NiCo_2O_4$ electrodes at the 1st cycle (a), at the 50th cycle (b), at the 100th cycle (c), at the 176th cycle (d).

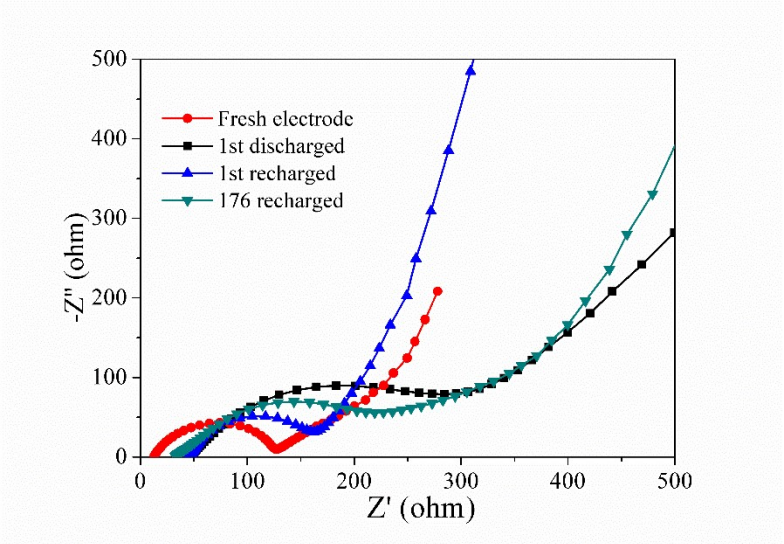

Fig. S9 Nyquist plots of NiO@$NiCo_2O_4$ electrodes at fresh, 1st cycle discharged, 1sr cycle recharged, and 176th cycle recharged states.

Table S3 Comparison of the Li-O_2 battery performance of NiO@$NiCo_2O_4$ cathode with those of NiO-based and $NiCo_2O_4$-based cathodes reported in the literature.

Materials	Current Density	1st Discharge Capacity	Cycles/ Fixed Capacity	Ref.
NiO@$NiCo_2O_4$@Ni	200 mA g^{-1}	8810.8 mA h g^{-}	176/500 mA h g^{-1}	This Work

		[1]		
RuO_2/NiO	250 mA g^{-1}	3240 mA h g^{-1}	50/500 mA h g^{-1}	[1]
Co_3O_4@$NiCo_2O_4$	100 mA g^{-1}	10645 mA h g^{-1}	225/500 mA h g^{-1}	[2]
$NiCo_2O_4$ nanowire	18 mA g^{-1}	980 mA h g^{-1}	13/500 mA h g^{-1}	[3]
Wave like $NiCo_2O_4$	100mA g^{-1}	4174 mA h g^{-1}	100/500 mA h g^{-1}	[4]
Au/$NiCo_2O_4$	42.5 mA g^{-1}	1275 mA h g^{-1}	40/510 mA h g^{-1}	[5]
$NiCo_2O_4$ microspheres	0.08 mA cm^{-2}	3163 mA h g^{-1}	60/500 mA h g^{-1}	[6]
bowl-like $NiCo_2O_4$	100 mA g^{-1}	9624.2 mA h g^{-1}	92/500 mA h g^{-1}	[7]
CeO_2@$NiCo_2O_4$	100 mA g^{-1}	6500 mA h g^{-1}	64/500 mA h g^{-1}	[8]
$NiCo_2O_4$ nanorods	0.1 mA cm^{-2}	1491.6 mA h g^{-1}	40/500 mA h g^{-1}	[9]
NCO-500	100 mA g^{-1}	9231 mA h g^{-1}	80/600 mA h g^{-1}	[10]

Reference

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