Electronic Supplementary Material (ESI) for Nanoscale Advances.

Electronic Supplementary Information

3D hierarchical self-supported $NiO/Co_3O_4@C/CoS_2$ nanocomposites as electrode materials for high-performance supercapacitor

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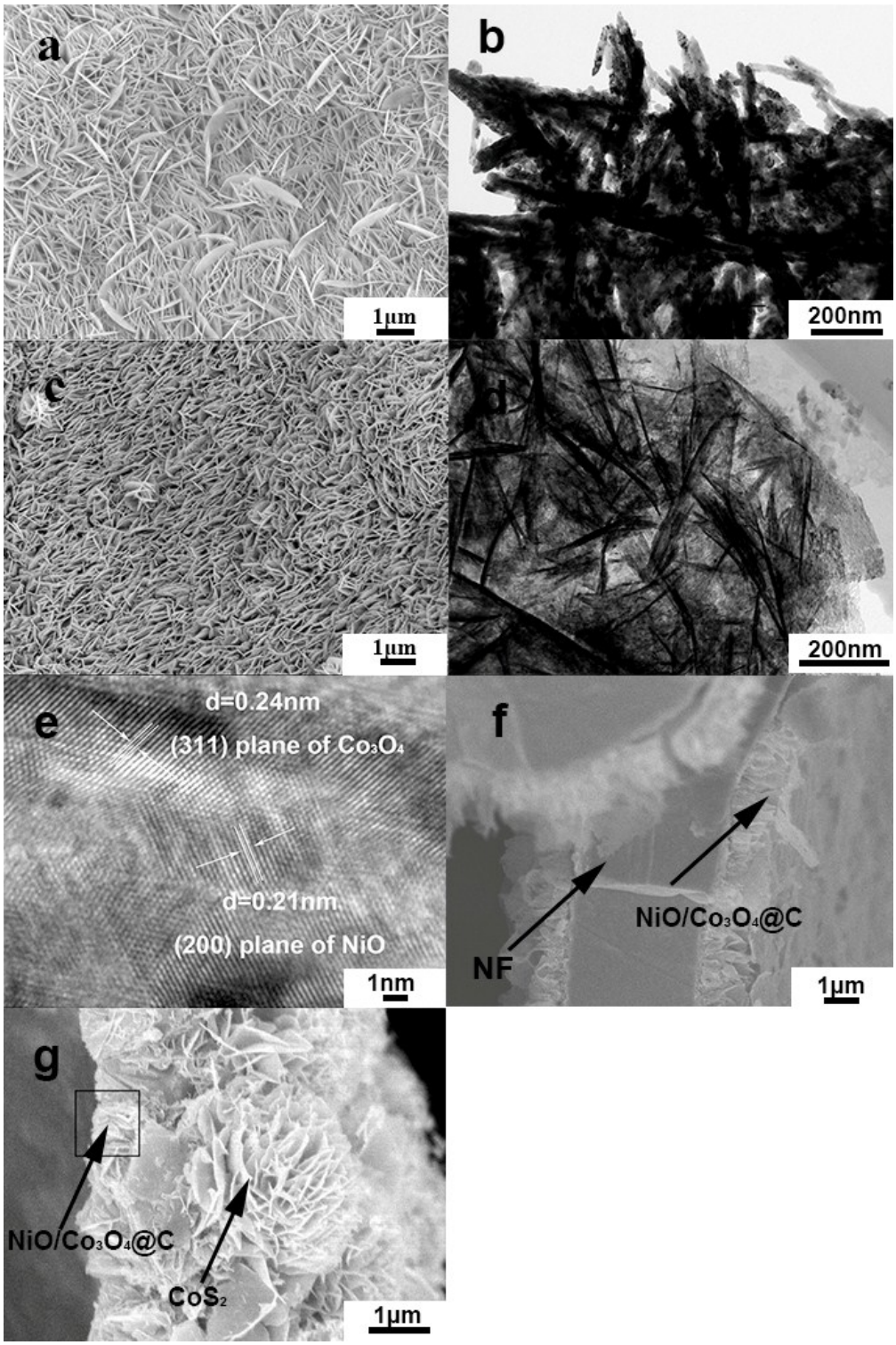

Fig. S1. (a) The typical SEM image of the Ni-Co LDH. (b) The typical TEM image of the Ni-Co LDH (c) The typical SEM image of the NiO/Co_3O_4@C. (d) The typical TEM image of NiO/Co_3O_4@C. (e)HRTEM image of NiO/Co_3O_4@C. The cross section of NiO/Co_3O_4@C and NiO/Co_3O_4@C/CoS_2 (f, g).

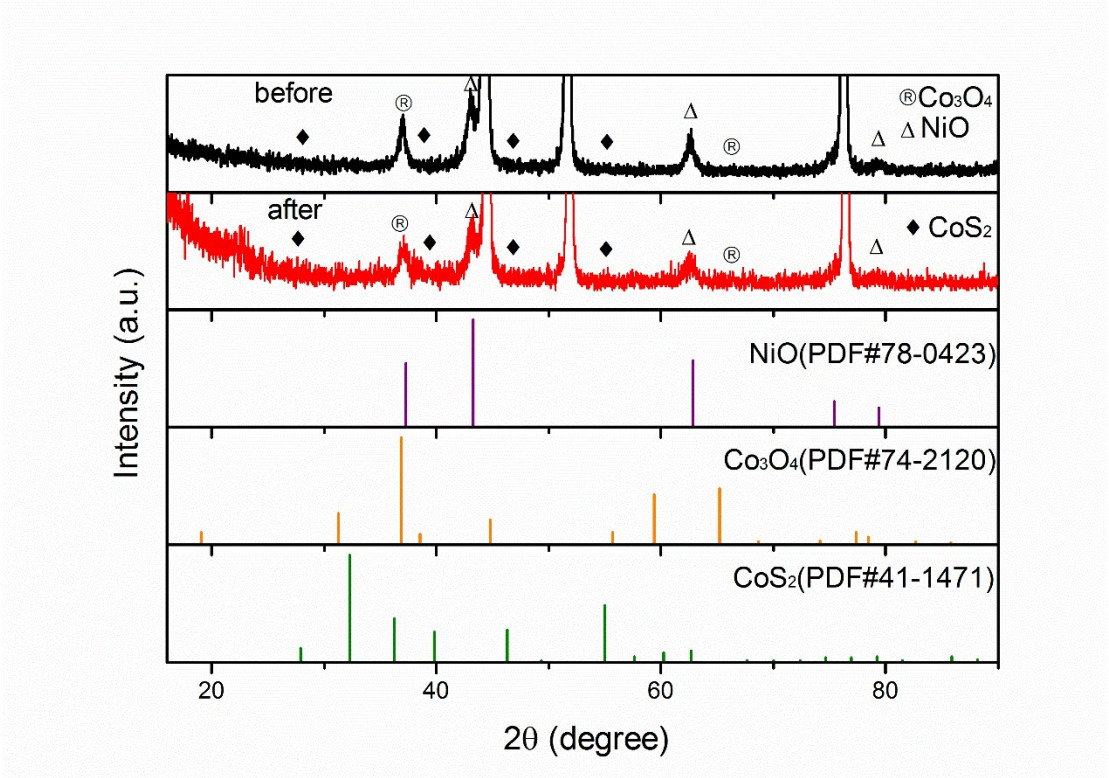

Fig. S2 The XRD results of $NiO/Co_3O_4@C/CoS_2$ sample before and after 5000 cycles.

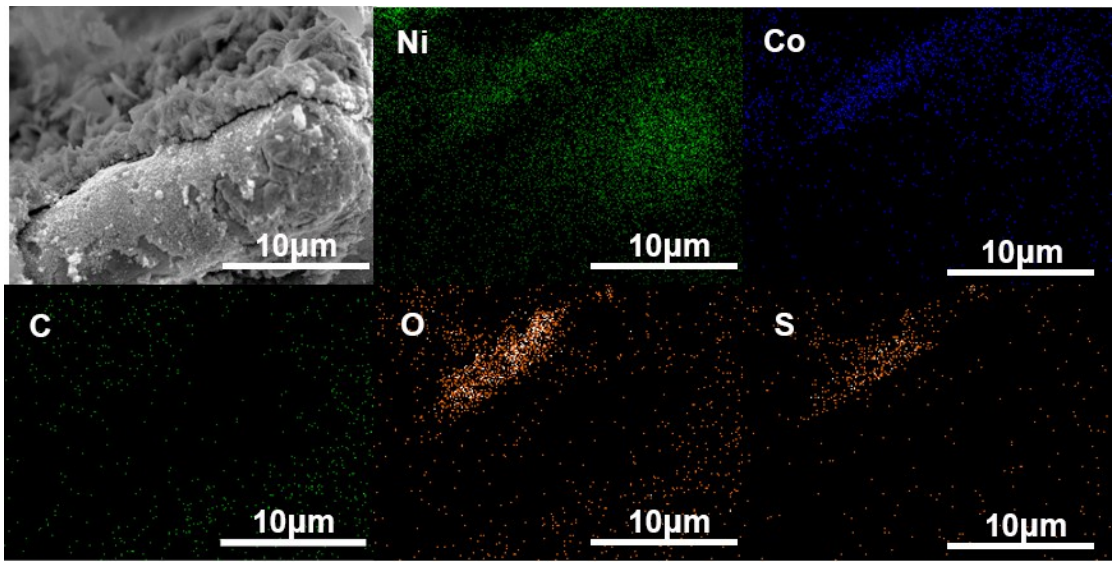

Fig. S3 Area distribution of S, Co, O, C and Ni elements in $NiO/Co_3O_4@C/CoS_2$.

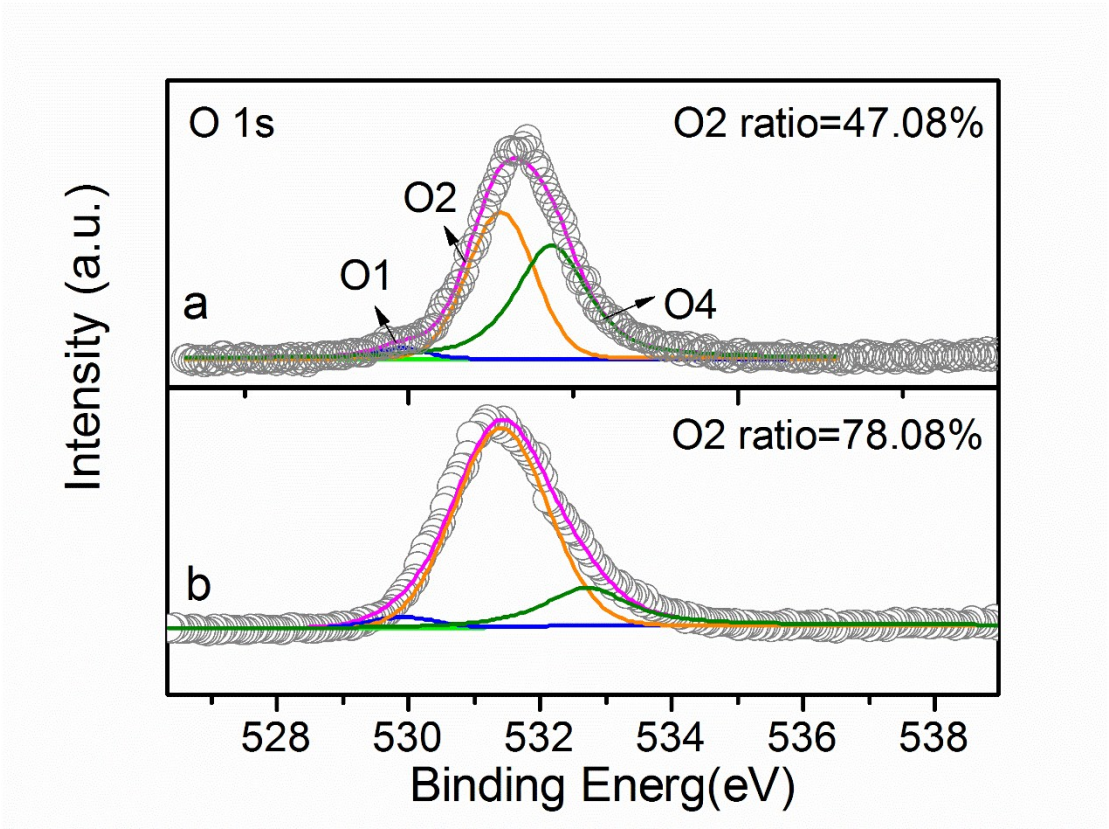

Fig. S4 Fitted O 1s for NiO@Co_3O_4@C (a) and for NiO/Co_3O_4@C/CoS_2(b).

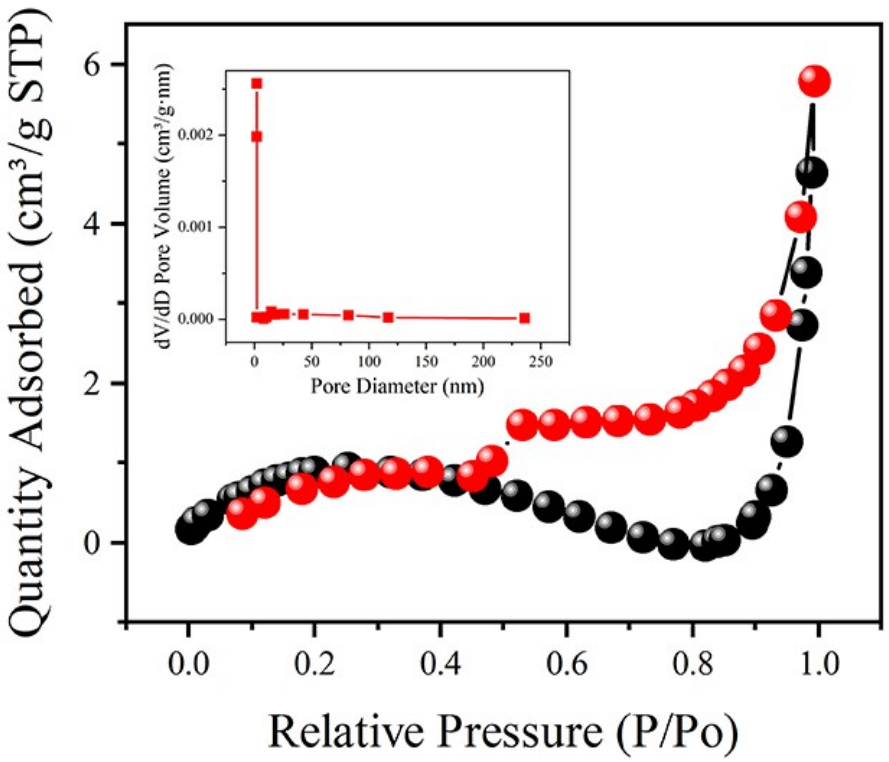

Fig. S5 Nitrogen adsorption–desorption isotherms and pore-size distribution (inset) of nickel foam coated with NiO/Co_3O_4@C sample.

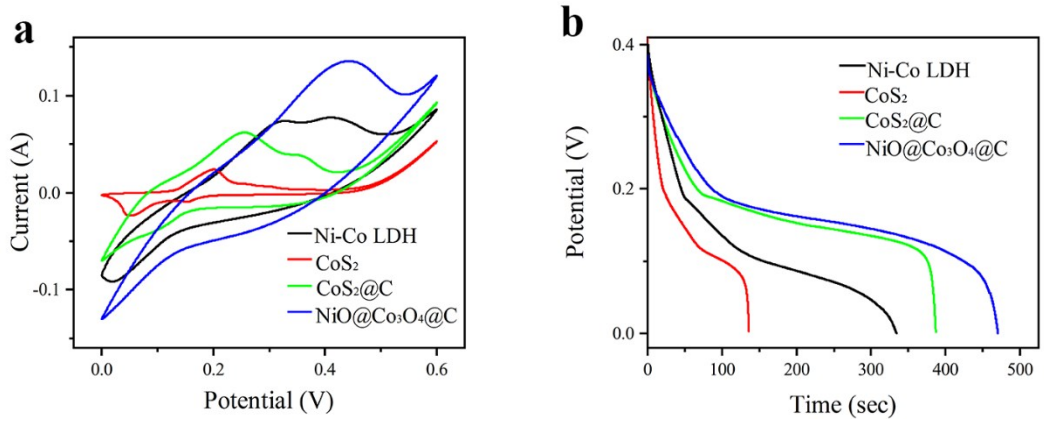

Fig. S6 The CV (a) and GCD (b) curves of as-prepared samples at scan rate 50 mV s^{-1} and current density of 2 A g^{-1}.

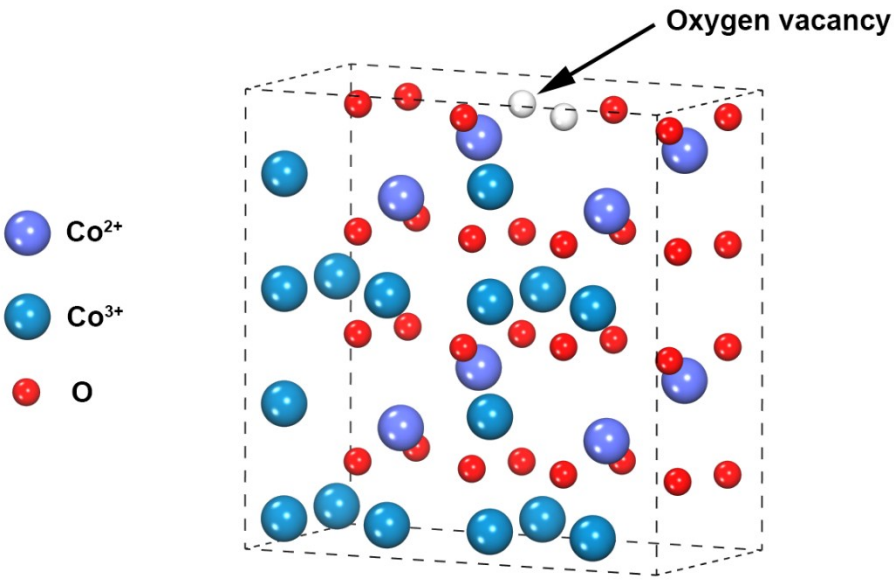

Fig. S7 Illustration of more oxygen vacancies presence in the surface of Co_3O_4 during the reaction of $Co^{3+}+S_2O_3^{2-}+5H_2O = 8Co^{2+}+2SO_4^{2-}+10H^+$.

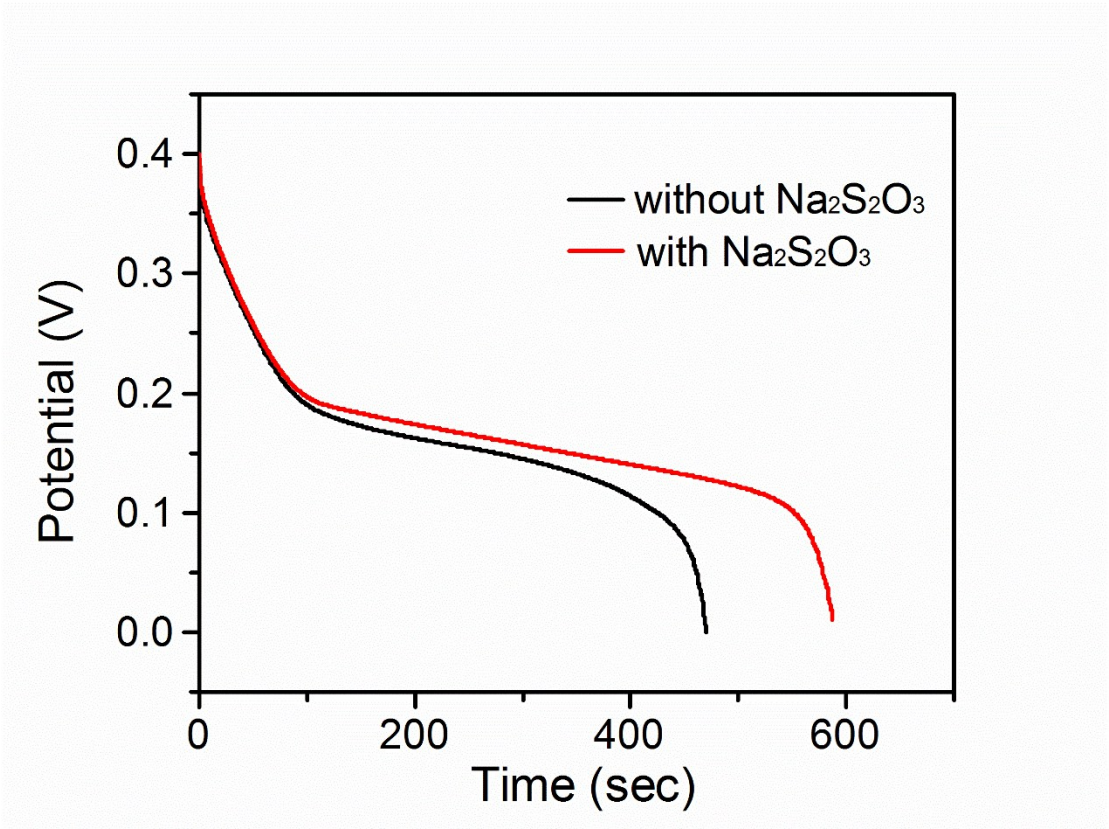

Fig. S8 GCD curves of the samples with or without $Na_2S_2O_3$.

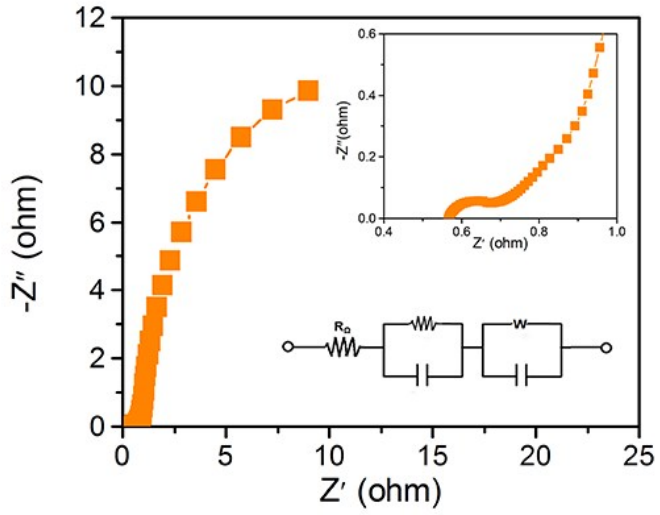

Fig. S9 Nyquist plot of the NiO/Co_3O_4@C/CoS_2 electrode with its equivalent circuit (inset) used to fit the experimental data.

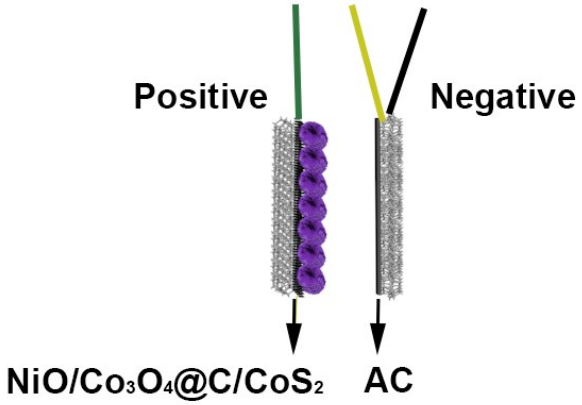

Fig. S10 Hybrid device of $NiO/Co_3O_4@C/CoS_2$//AC.

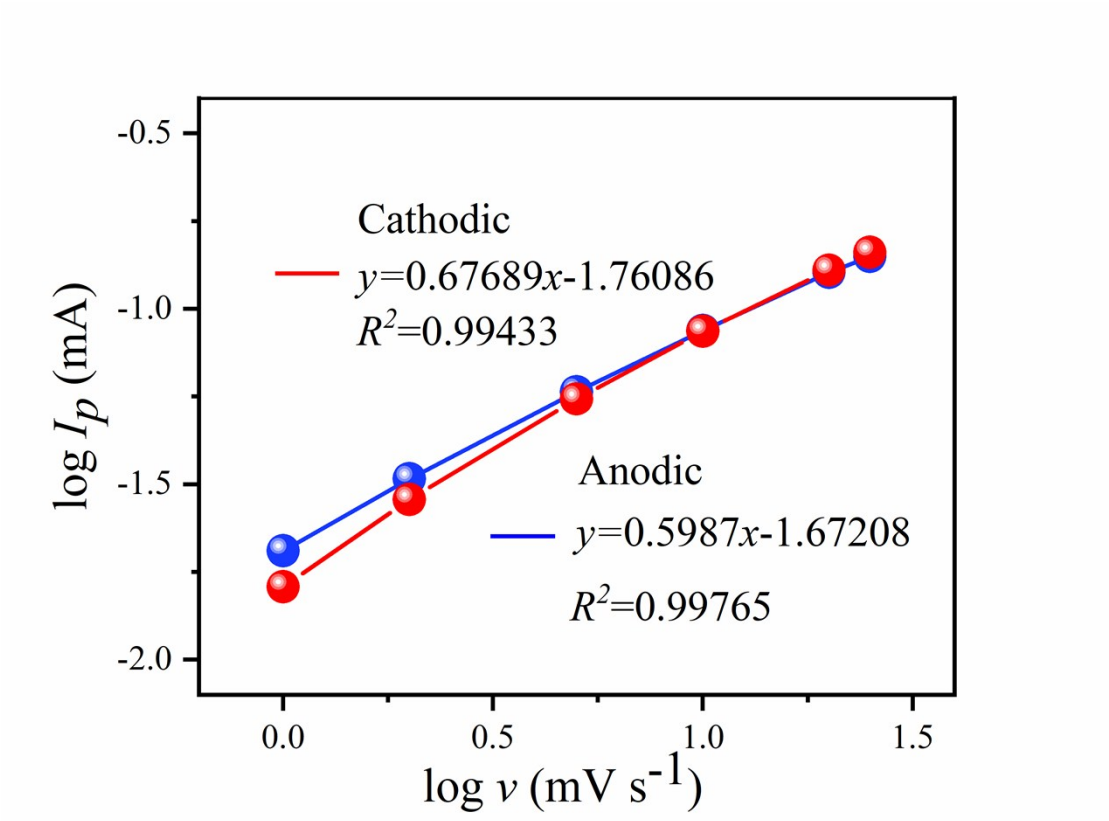

Fig. S11 The electrochemical behavior of $NiO/Co_3O_4@C/CoS_2$.

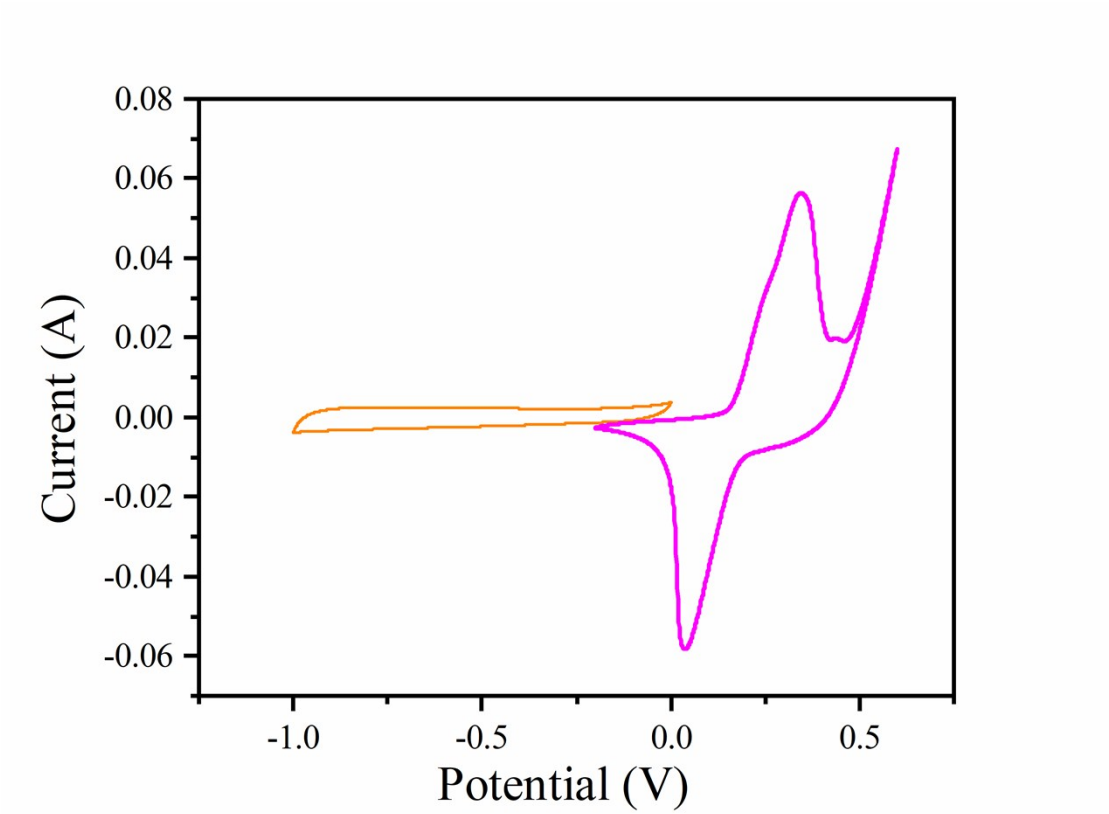

Fig. S12 Cyclic voltammograms of the $NiO/Co_3O_4@C/CoS_2$ electrode and activated carbon (AC) electrodes performed in a three-electrode system in 6 M KOH solution at a scan rate of 5 mV s^{-1}.

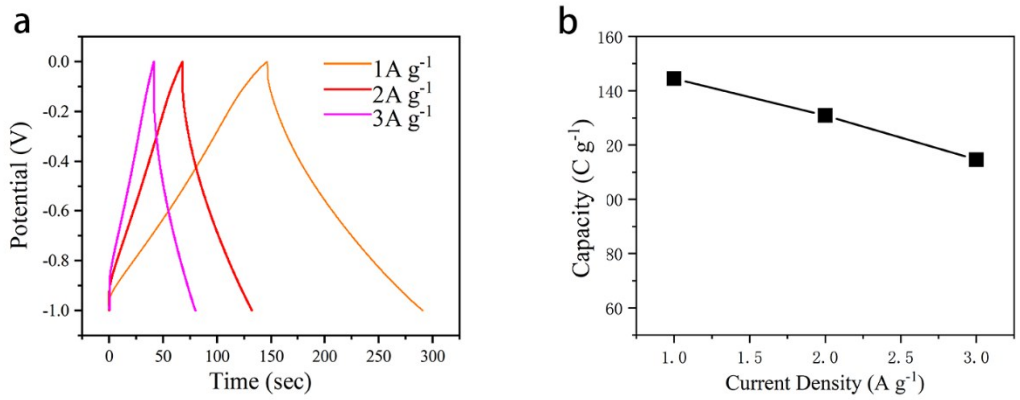

Fig. S13 (a) GCD curves of AC electrode at various current densities. (b) Rate performance of the AC electrode at various scan rates from 1 A g^{-1} to 3 A g^{-1}.

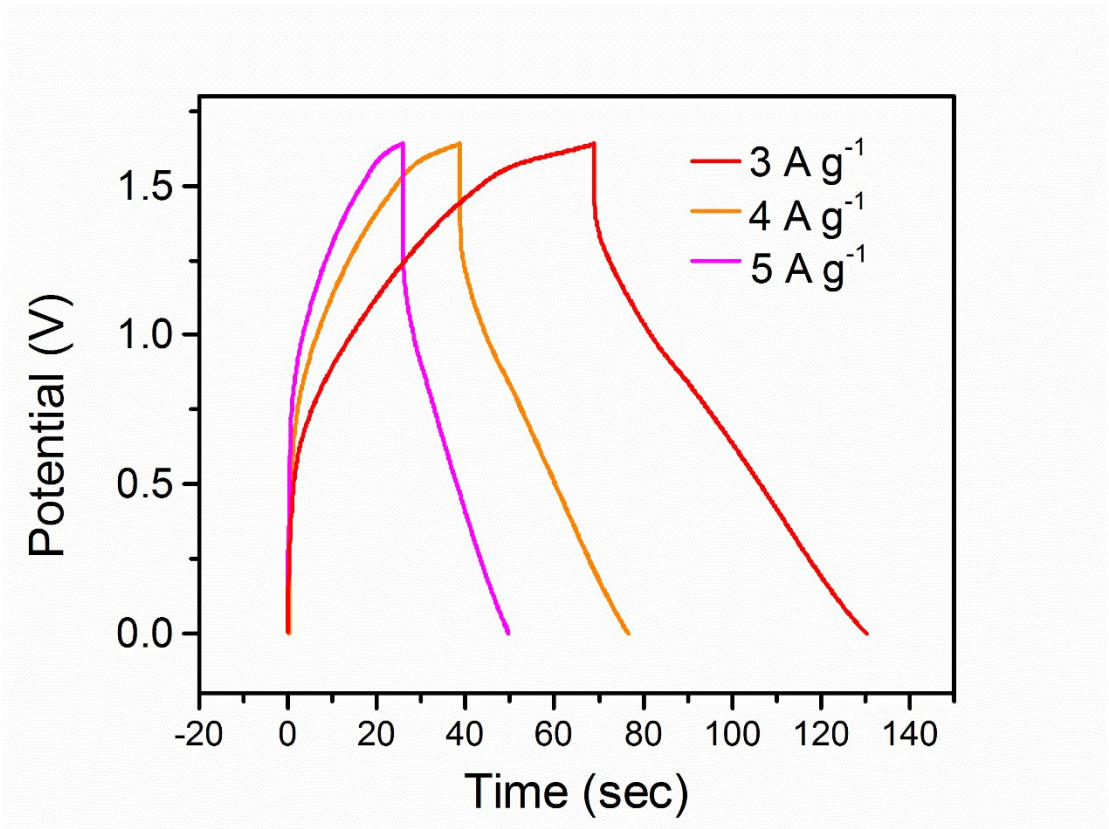

Fig. S14 GCD curves of $NiO/Co_3O_4@C/CoS_2$//AC hybrid device at different current densities.

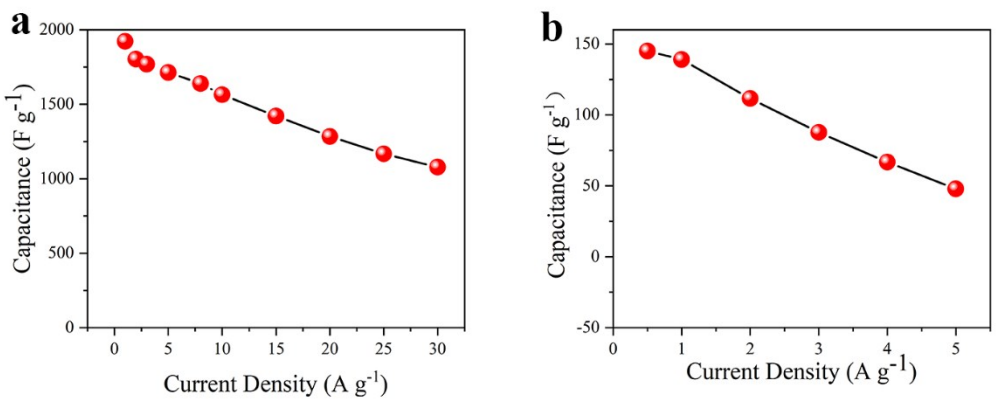

Fig. S15 Rate performance of $NiO/Co_3O_4@C/CoS_2$ hybrid electrode at various scan rates from 1 A g^{-1} to 30 A g^{-1}; (b) Rate performance of $NiO/Co_3O_4@C/CoS_2$//AC hybrid device at various scan rates from 0.5 A g^{-1} to 5 A g^{-1}.

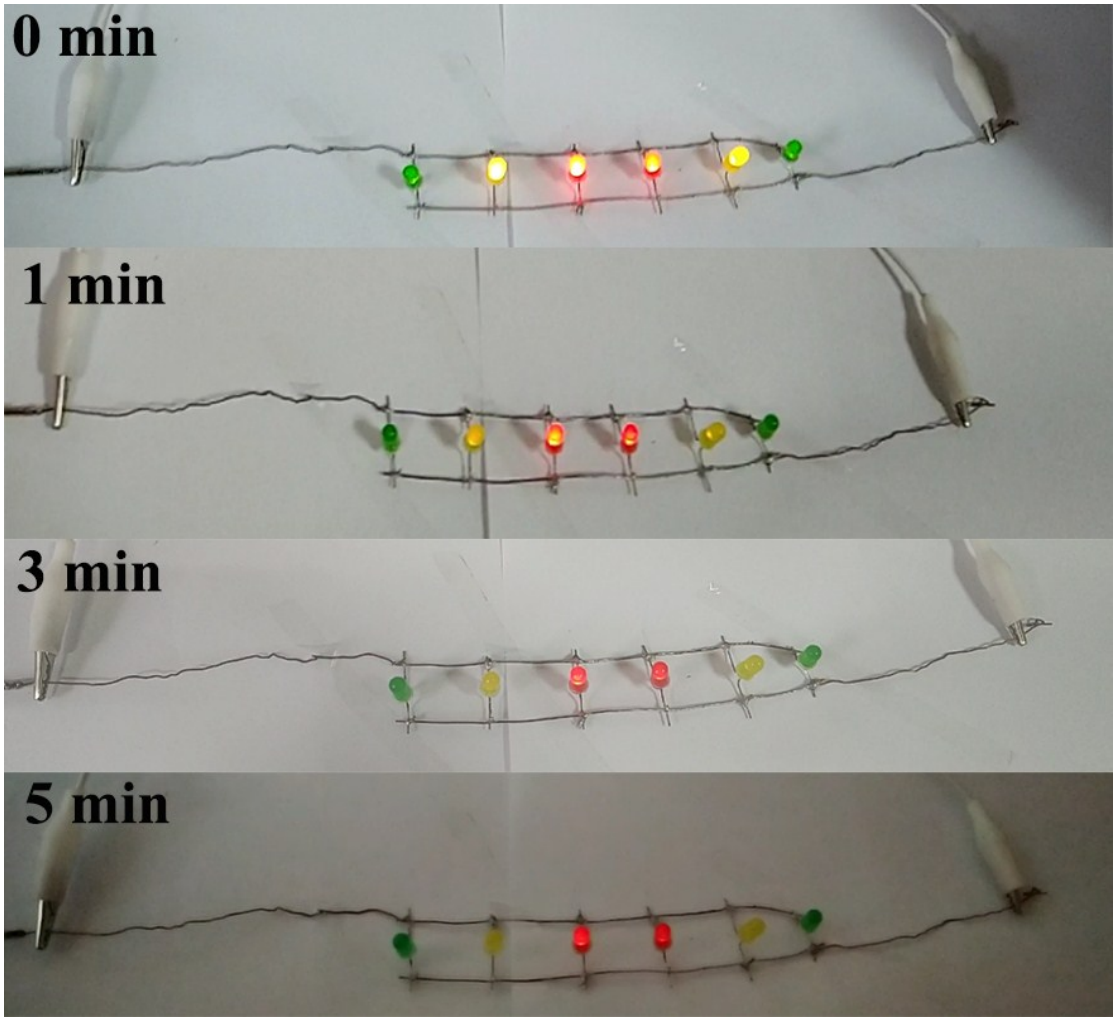

Fig. S16 Real application of the two NiO/Co_3O_4@C/CoS_2//AC devices for lighting six LEDs at the same time.

Table S1 Comparison of electrochemical performance of some reported electrode materials.

Samples	Highest capacity (F g^{-1})	High rate performance	Ref
G-$Ni(OH)_2/MoS_2$	1950 F g^{-1} at 1 A g^{-1}	1400 F g^{-1} at 1 A g^{-1}	[1]
$NiCo_2O_4$/NiO/ Co_3O_4	1693 F g^{-1} at 1 A g^{-1}	~1480 F g^{-1} at 10 A g^{-1}	[2]
Co_3O_4-NiO/graphene foam	783 F g^{-1} at 1 A g^{-1}	583 F g^{-1} at 10 A g^{-1}	[3]
MnO_2@NiCo-LDH/CoS_2	1547 F g^{-1} at 1 A g^{-1}	1189 F g^{-1} at 10 A g^{-1}	[4]
CoO/Co-Cu-S	2300 F g^{-1} at 2 A g^{-1}	~1702 F g^{-1} at 30 A g^{-1}	[5]
NiO/Co_3O_4@C/ CoS_2	1024 C g^{-1} at 1A g^{-1}	~759 C g^{-1} at 30 A g^{-1}	This work

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