Electronic Supplementary Information

# Urchin-like NiO-$NiCo_2O_4$ heterostructure microsphere catalysts for enhanced rechargeable non-aqueous Li-$O_2$ batteries

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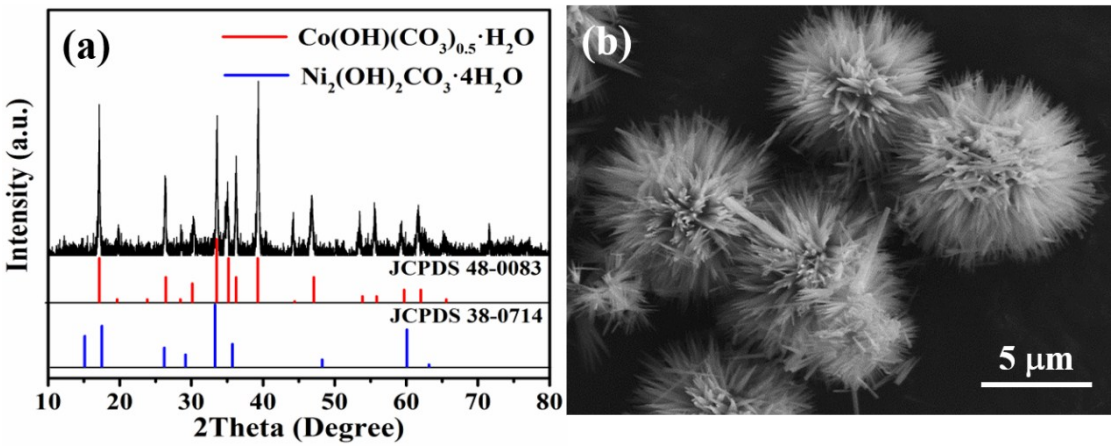


**Fig. S1**. (a) XRD pattern and (b) SEM image of NiO-$NiCo_2O_4$ precursor.

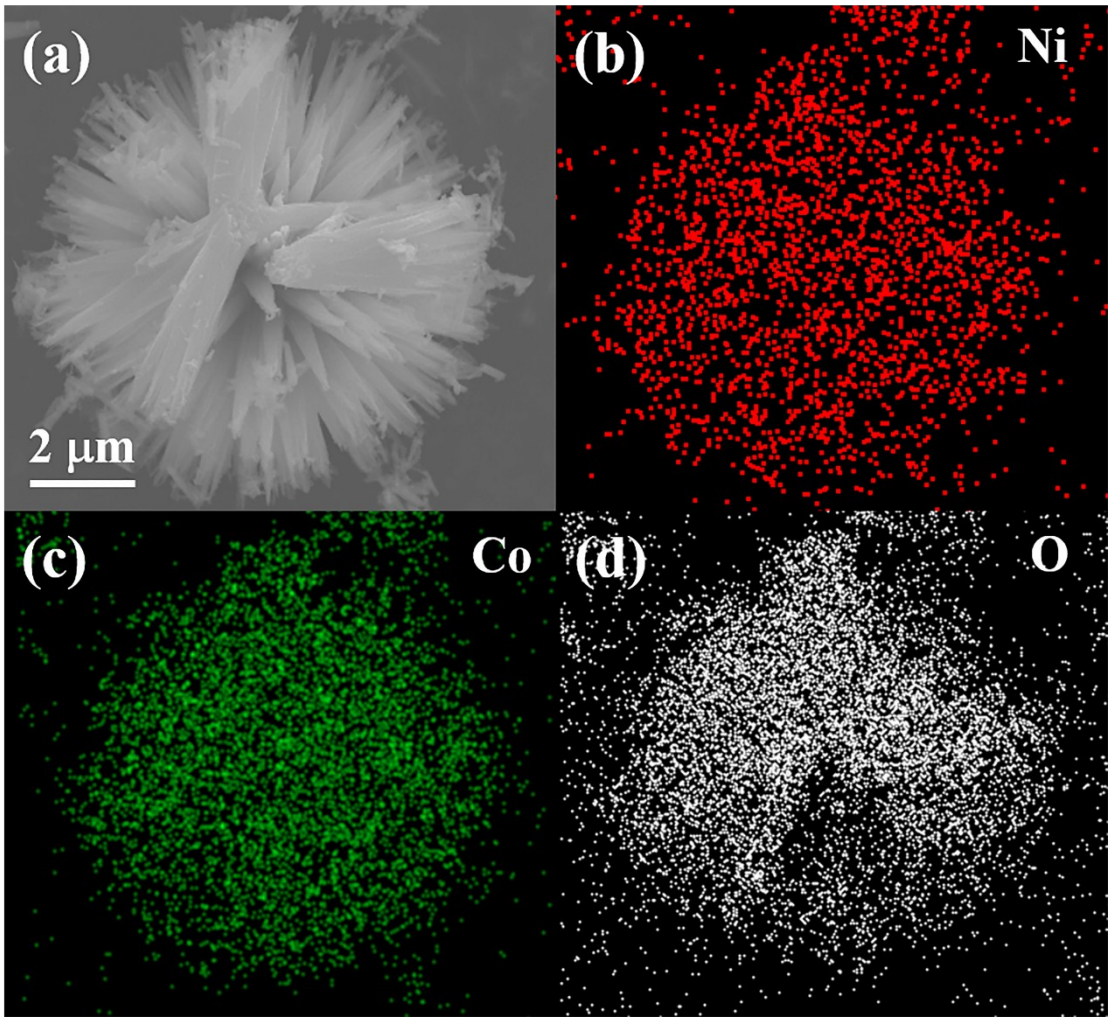


**Fig. S2** (a) SEM image and (b)-(d) corresponding element mapping images of NCO-400.

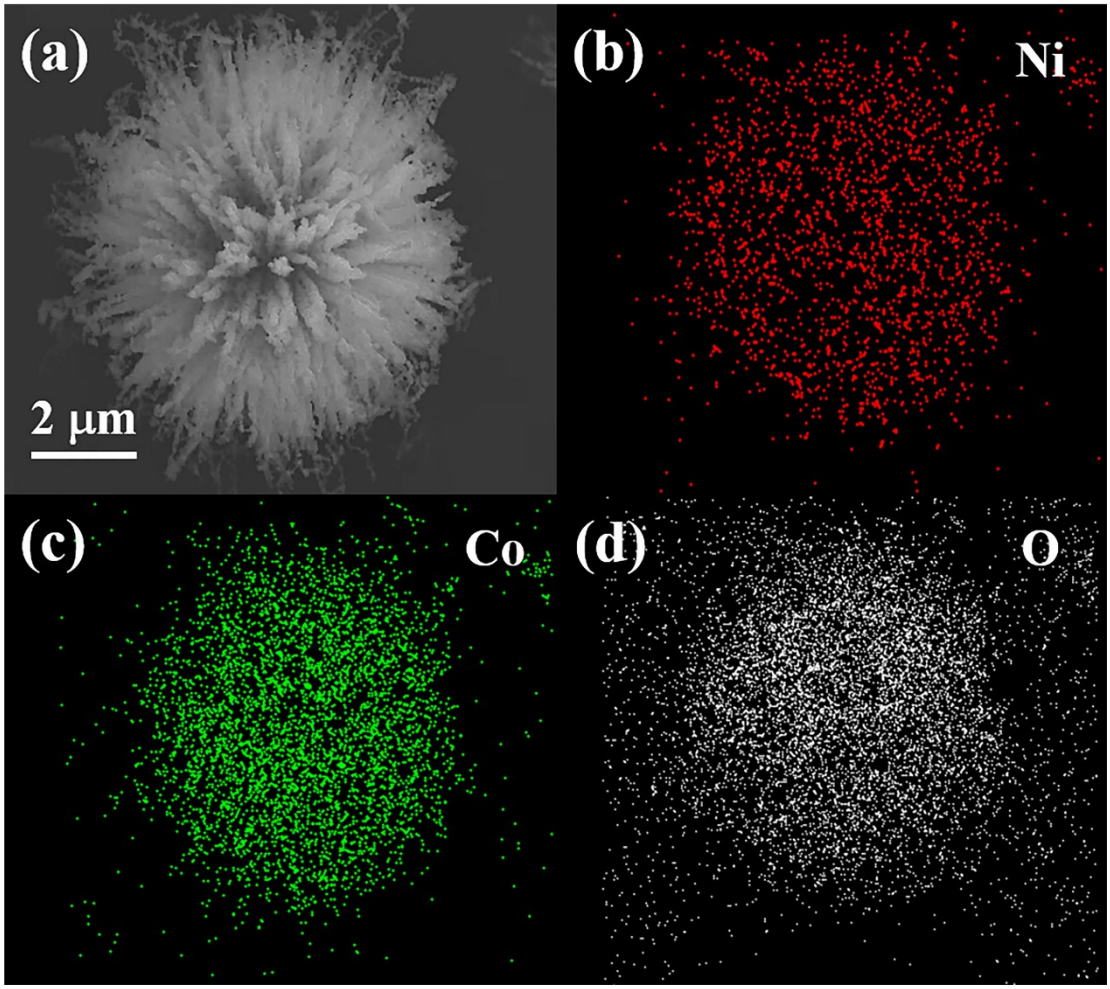


**Fig. S3** (a) SEM image and (b)-(d) corresponding element mapping images of NCO-600.

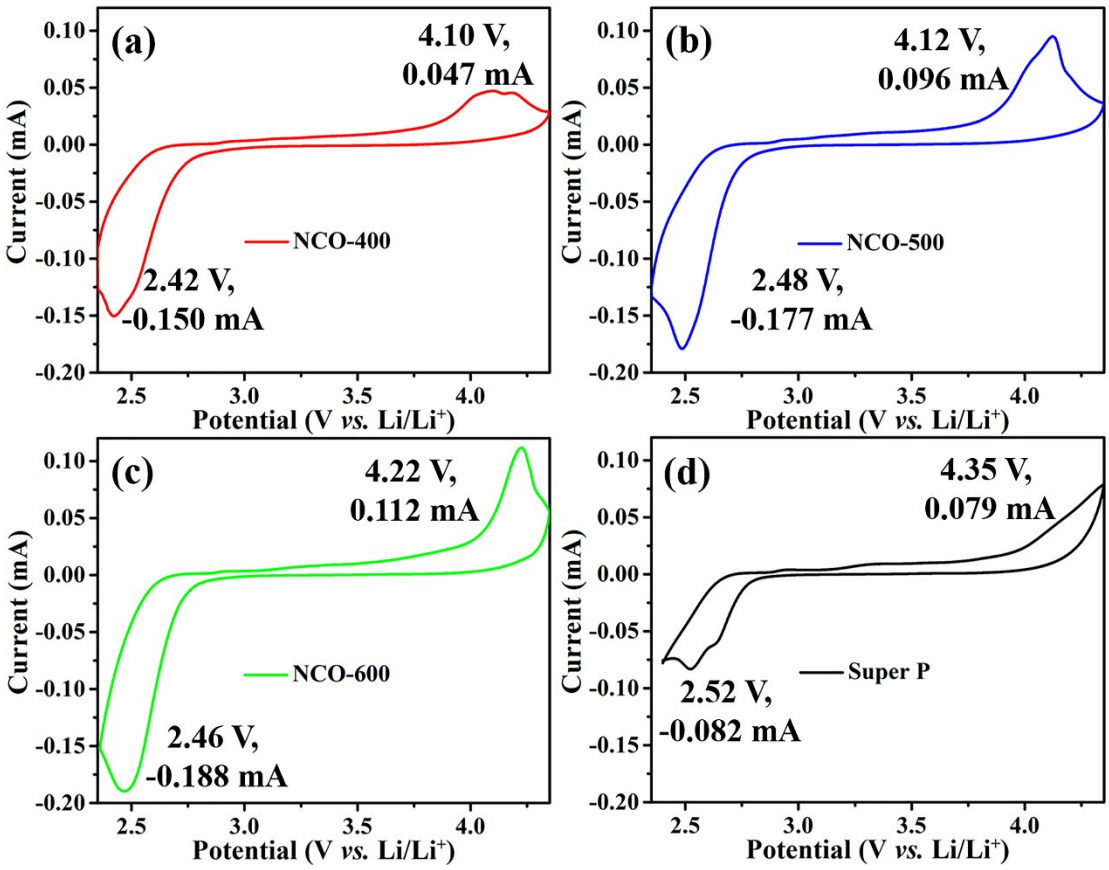


**Fig. S4** CV curves of (a) NCO-400, (b) NCO-500, (c) NCO-600 and (d) SP electrodes.

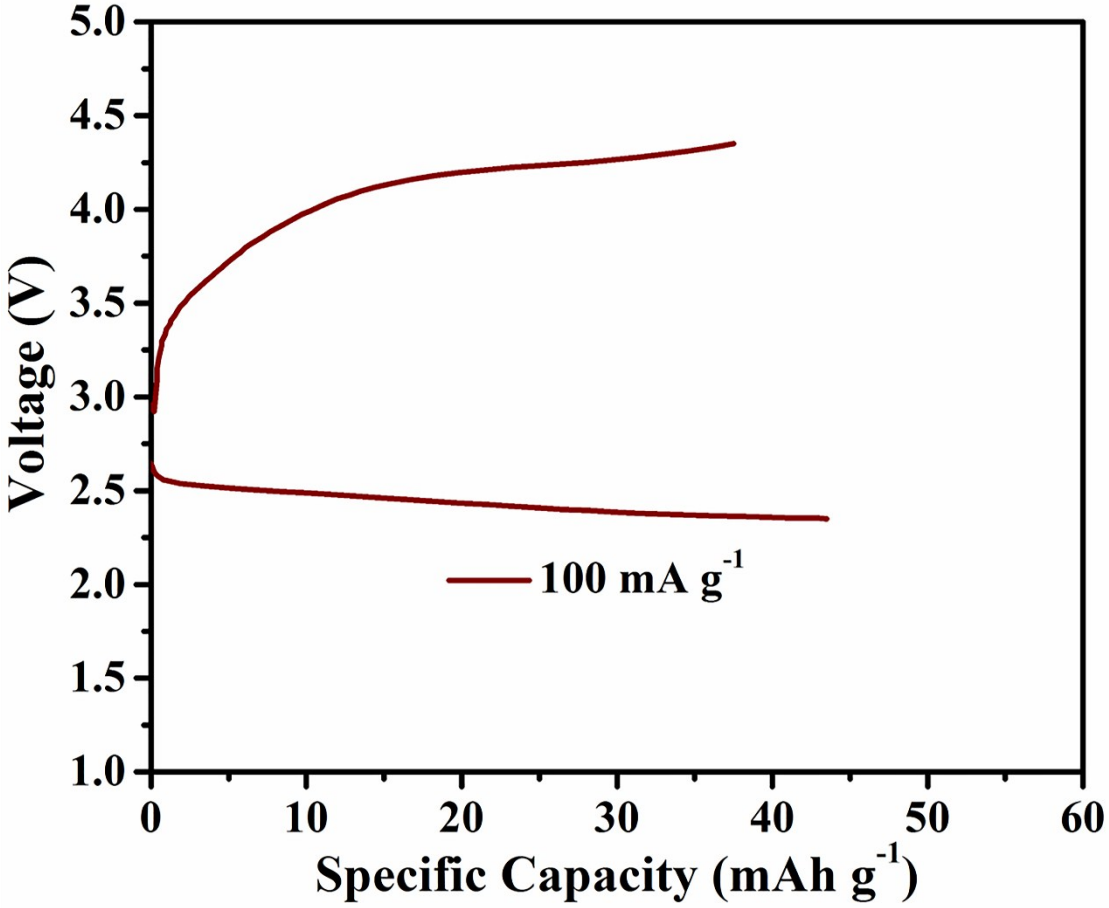


**Fig. S5** Initial discharge/charge profiles of Li-$O_2$ battery containing carbon paper cathode from 2.35 to 4.35 V at 100 mA $g^{-1}$.

**Table S1** Comparison of the Li-$O_2$ battery performance of NCO-500 cathode with those of NiO-based and $NiCo_2O_4$-based cathodes reported in the literature.

| Materials | Current Density | 1st Discharge Capacity[a] | Cycles/ Fixed Capacity | Ref. |
|---|---|---|---|---|
| **NCO-500** | 100 mA $g^{-1}$ | 9231 mAh $g^{-1}$ | 80/600 mAh $g^{-1}$ | This work |
| **$RuO_2$/NiO** | 250 mA $g^{-1}$ | 3240 mAh $g^{-1}$ | 50/500 mAh $g^{-1}$ | 1 |
| **NiO nanosheets** | 100 mA $g^{-1}$ | 1260 mAh $g^{-1}$ | 40/500 mAh $g^{-1}$ | 2 |
| **$NiCo_2O_4$ nanowire array/ carbon cloth** | 18 mA $g^{-1}$ | 980 mAh $g^{-1}$ | 13/500 mAh $g^{-1}$ | 3 |
| **Wave like $NiCo_2O_4$** | 100mA $g^{-1}$ | 4174 mAh $g^{-1}$ | 100/500 mAh $g^{-1}$ | 4 |
| **Au/$NiCo_2O_4$** | 42.5 mA $g^{-1}$ | 1275 mAh $g^{-1}$ | 40/510 mAh $g^{-1}$ | 5 |
| **$NiCo_2O_4$ microspheres** | 0.08 mA $cm^{-2}$ | 3163 mAh $g^{-1}$ | 60/500 mAh $g^{-1}$ | 6 |
| **Ordered mesoporous $NiCo_2O_4$** | 0.1 mA $cm^{-2}$ | 4357 mAh $g^{-1}$ | 20/1000 mAh $g^{-1}$ | 7 |
| **Mesoporous spinel $NiCo_2O_4$** | 0.4 mA $cm^{-2}$ | 4358 mAh $g^{-1}$ | 35/1000 mAh $g^{-1}$ | 8 |
| **$NiCo_2O_4$ nanoflakes** | 0.2 mA $cm^{-2}$ | 1560 mAh $g^{-1}$ | 50/300 mAh $g^{-1}$ | 9 |
| **$NiCo_2O_4$ porous nanorods** | 0.1 mA $cm^{-2}$ | 1491.6 mAh $g^{-1}$ | 40/500 mAh $g^{-1}$ | 10 |

[a]The discharge capacities were calculated based on the amount of catalyst in the cathodes.

# References


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