**Supporting information**

# Ant-nest-like $Cu_{2-x}Se$@C with biomimetic channels boosts cycling performance of lithium storage

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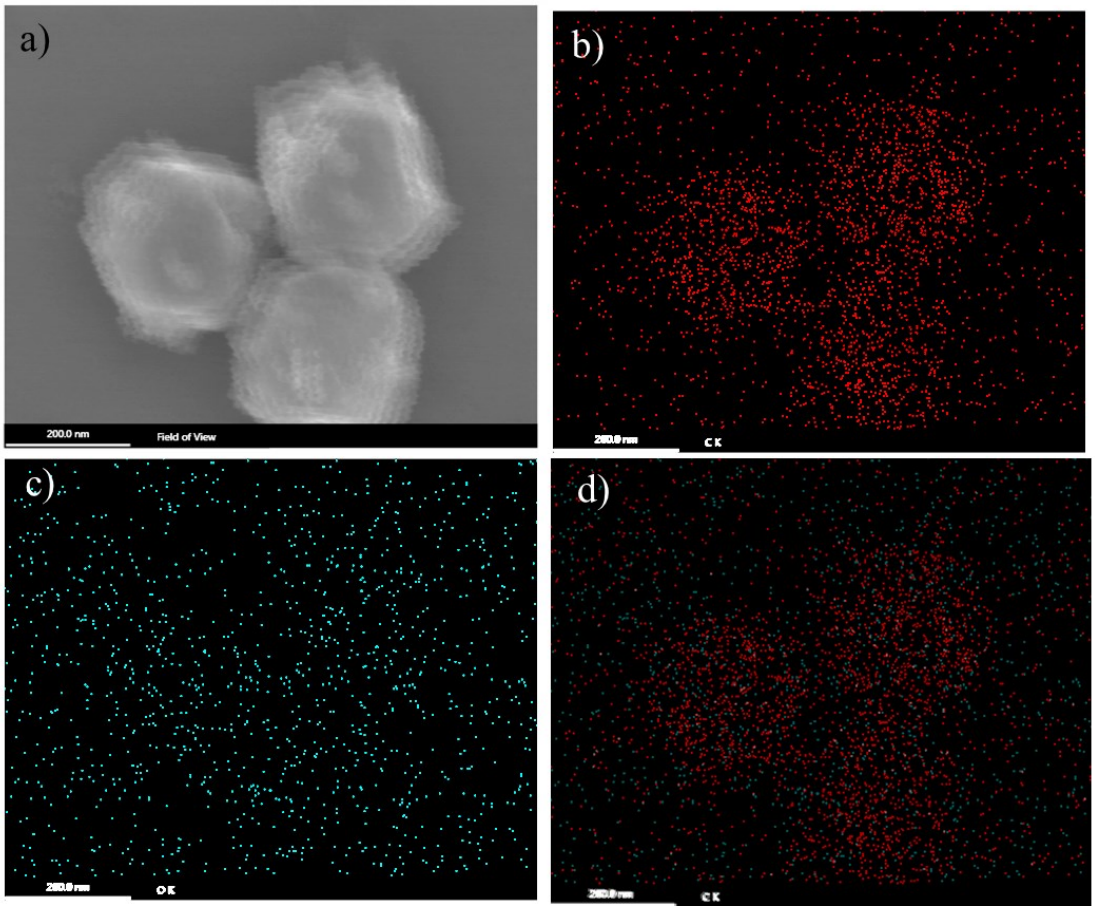


**Fig. S1** EDX elemental mapping images of the P-Cu@C, (a) field of view, (b) Cu, (c) C, (d) overlap image of the Cu and C.

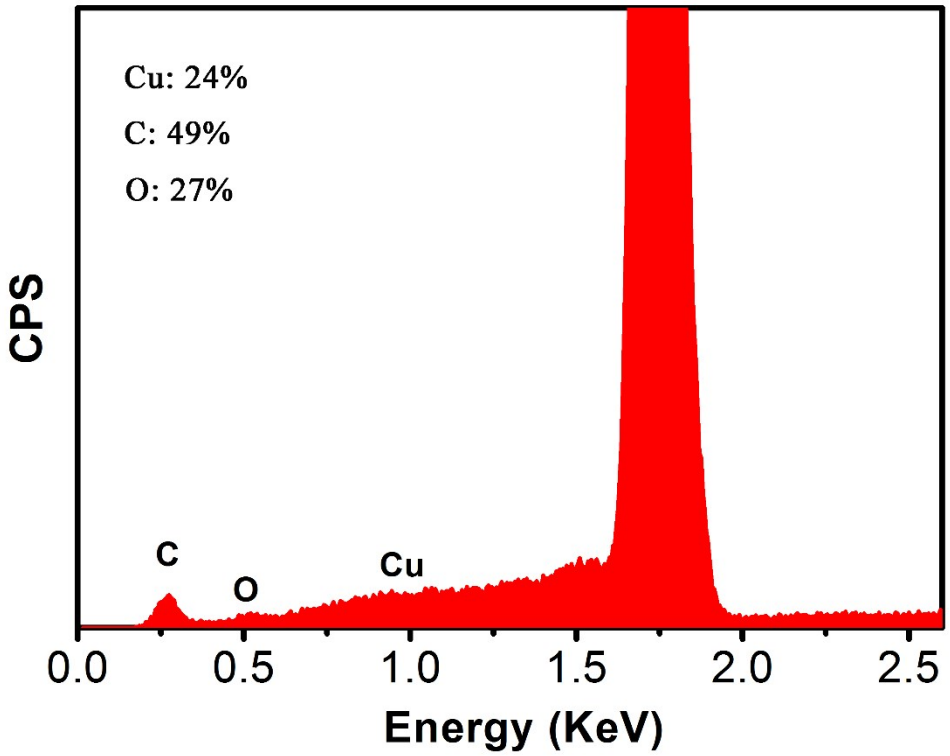


**Fig. S2** EDS plot of the P-Cu@C. The dominated peak at 1.75 KeV is related to the Si, which was used as substrate for the SEM test.

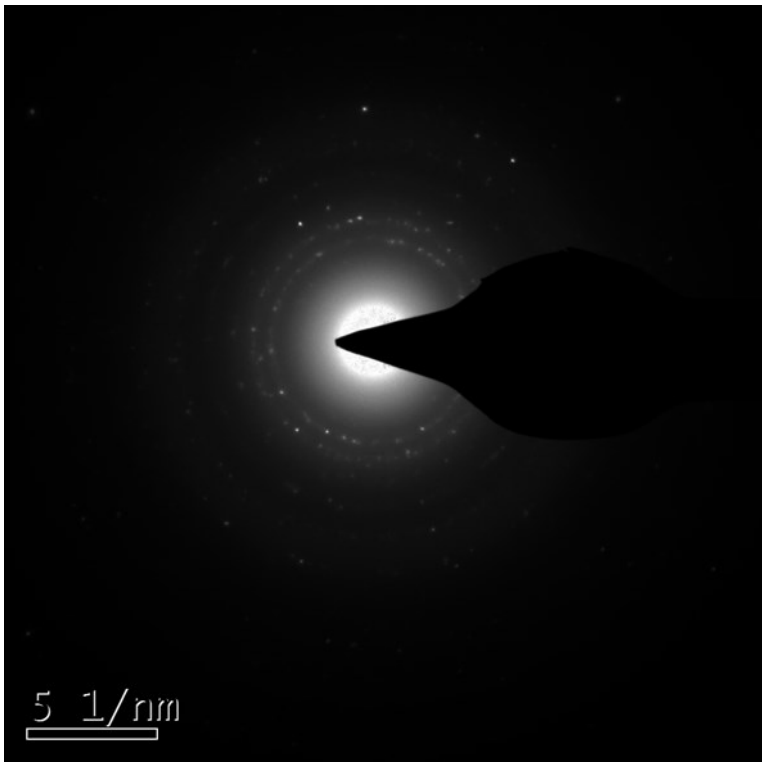


**Fig. S3** SAED images of the P-Cu@C

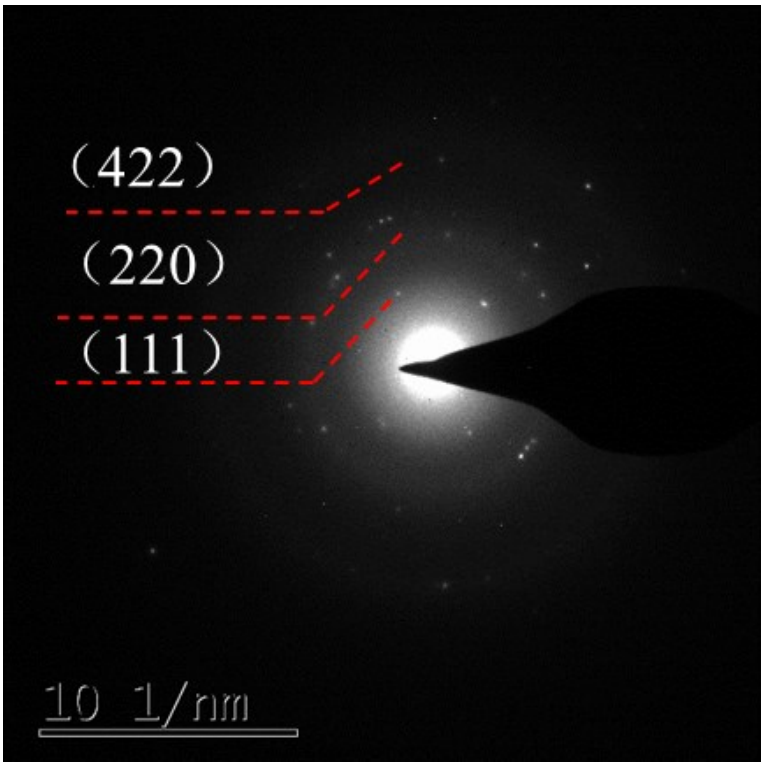


**Fig. S4** SAED images of the AN-$Cu_{2-x}Se$@C

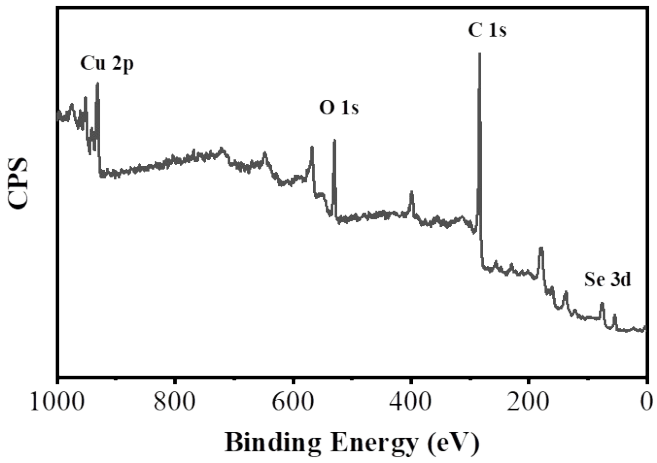


**Fig. S5** XPS survey of the AN-$Cu_{2-x}Se$@C at a lower magnification

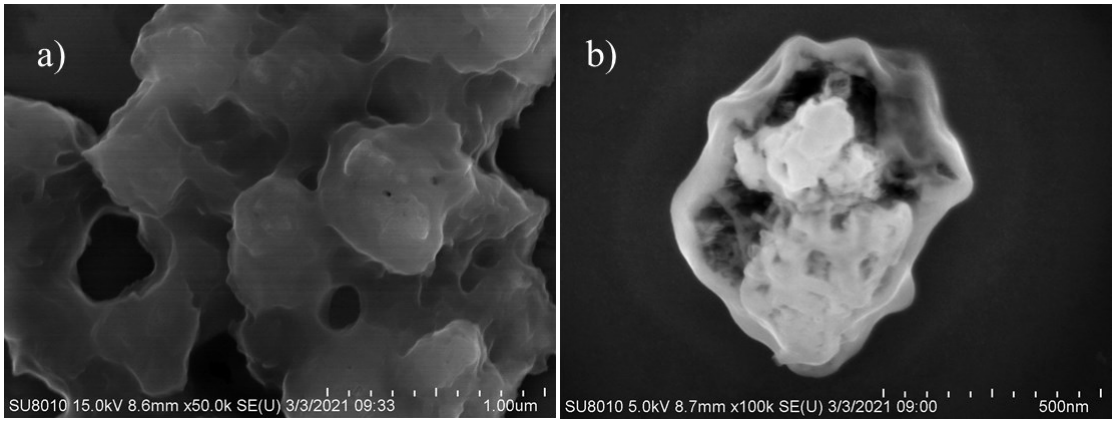


**Fig. S6** SEM images of the after cycled AN-$Cu_{2-x}Se$@C electrode (a) overview, (b) cross-view of an individual AN-$Cu_{2-x}Se$@C particle.

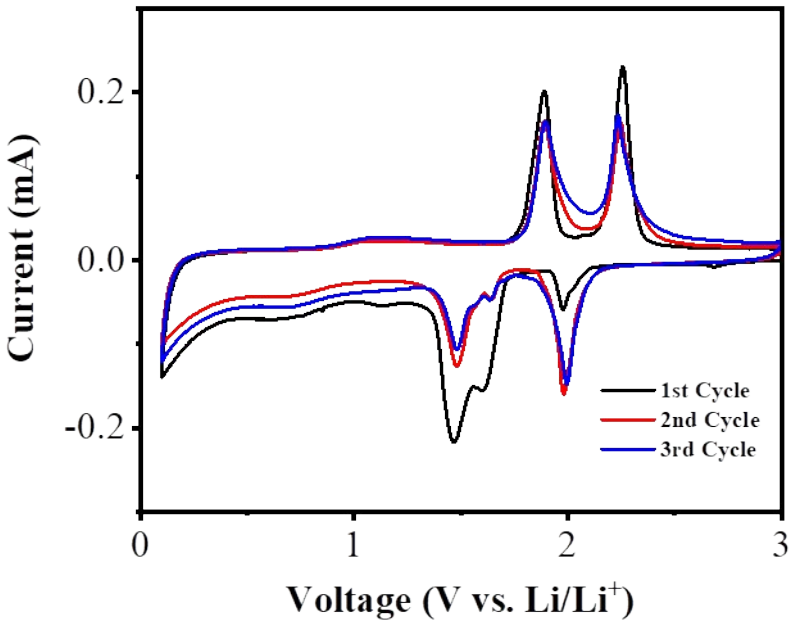


**Fig. S7** CV plots for the AN-$Cu_{2-x}Se$@C at initial cycles at a scan rate of 0.1 mV $s^{-1}$.

During the initial cycles two pair of obvious redox peaks were observed in the CV profiles, indicating a typical stepwise conversion type mechanism. The possible electrochemical reactions can be expressed as follows:

Discharge: $Cu_{2-x}Se + yLi^+ + ye^- \rightarrow Li_yCu_{2-x}Se$

$Li_yCu_{2-x}Se + (2-y)Li^+ + (2-y)e^- \rightarrow Li_2Se + (2-x)Cu$

Charge: $Li_2Se + (2-x)Cu \rightarrow Cu_{2-x}Se + 2Li^+ + 2e^-$

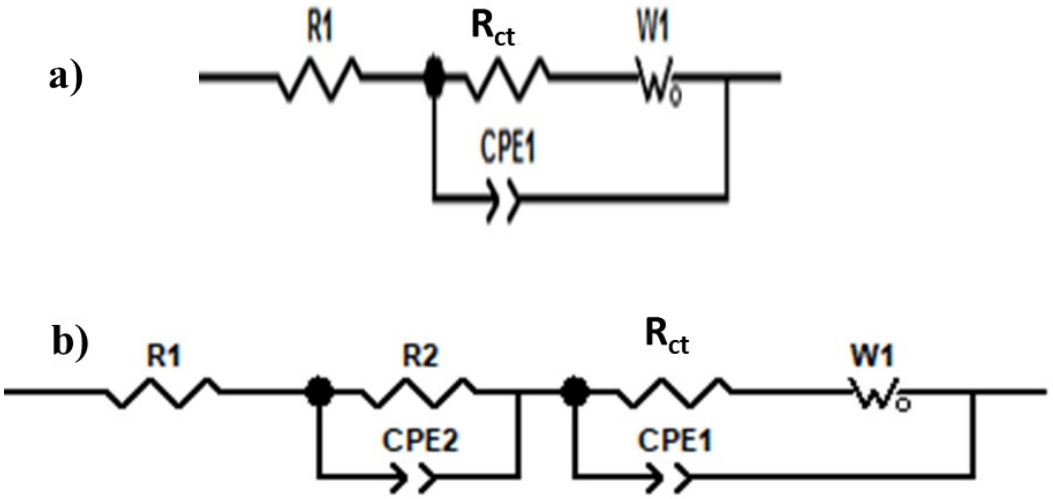


**Fig. S8** Equivalent circuit model for (a) fresh electrode, and (b) electrodes after different cycles

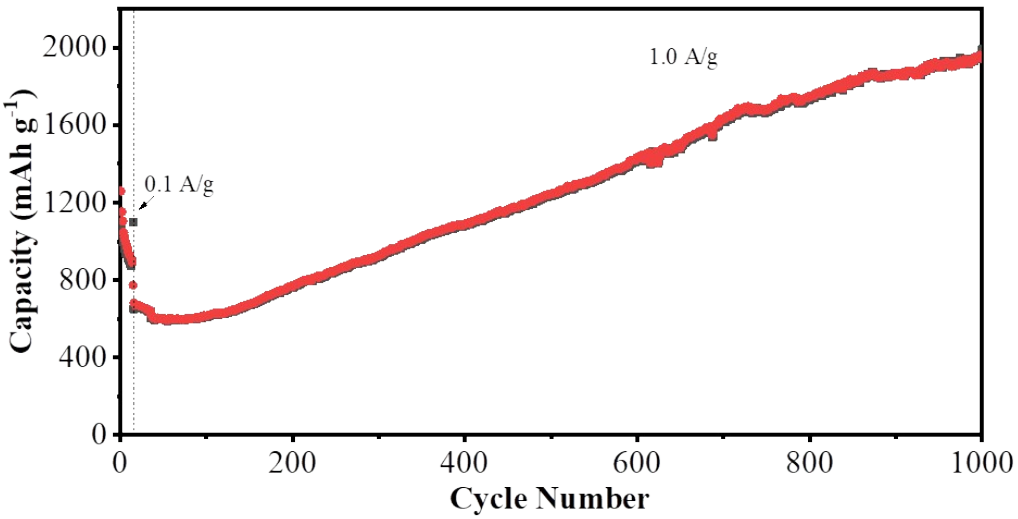


**Fig. S9** Cycling performance of the AN-$Cu_{2-x}Se$@C before rate performance.