

We utilized CuS or C@CuS nanopowders as raw materials and fabricated cylindrical samples with a thickness of 0.4 cm and a diameter of 1 cm through a series of processes including pressure application, argon gas protection sintering, electrode coating, and drying. Subsequently, the voltage-current curves of the samples were measured. Finally, the electrical conductivity of the CuS and C@CuS nanopowders was calculated to be 0.55 and 84.1 Sm^{-1} , respectively, using the electrical conductivity formula. Figure S1 shows the voltage-current curve of the samples, which prove that the resistance of cylindrical CuS and C@CuS samples are 93.2 and 1.1 Ω , respectively.

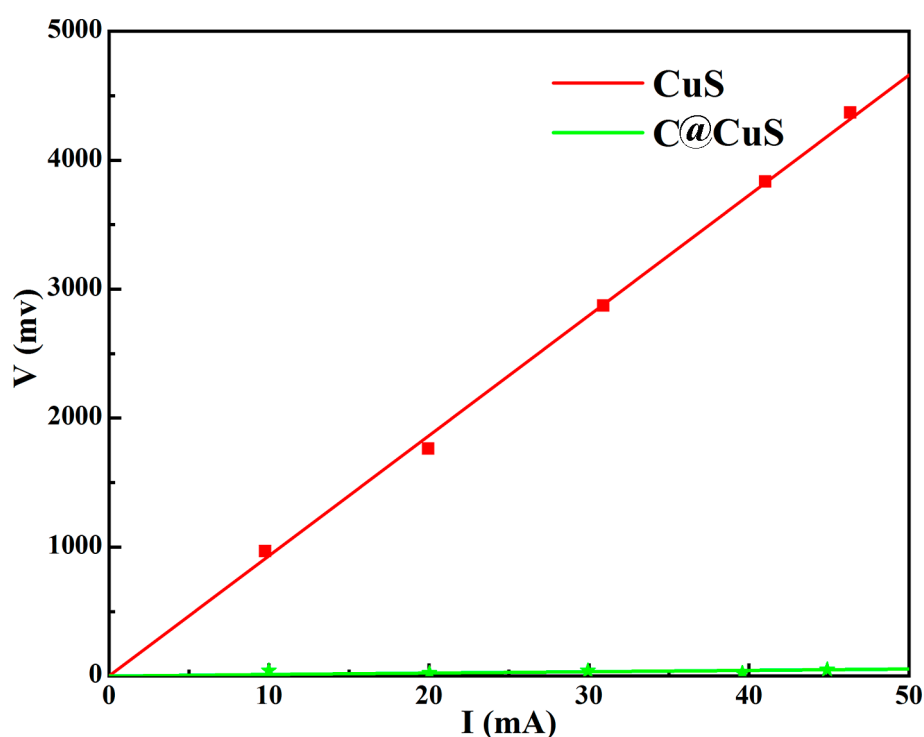


Figure S1 The voltage-current curve of the samples.

Figure S2a and S2b present SEM images of the CuS electrode before and after 800 cycles at a 1000 mA g^{-1} current density. On the submicron scale, the integrity of the electrode structure has been maintained after cycling. It can be found that after

charging and discharging, the original nanoscale particulate matter became aggregates and few microcracks with widths of roughly 50~500 nm and lengths of roughly 5 μm appeared, indicating the occurrence of some volume changes. The accompanying EDS images in Figure S2d and S2e display relatively uniform distribution of Cu and S across the electrode surface, confirming the structural integrity of CuS is preserved after 800 cycles, aligning with its performance in the charge-discharge process.

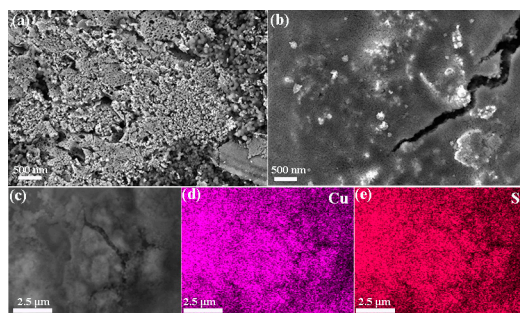


Figure S2 SEM image of CuS before (a) and after (b) 800 cycles at a current density of 1000 mA g^{-1} ; SEM image (c), and corresponding elemental mapping of Cu (d) , S (e) of CuS after 800 cycles.