Supporting Information

Controlled-Synthesis of Copper Telluride Nanostructures for Long-cycling Anodes in Lithium Ion Batteries

Chao Han, Zhen Li*, Wei-jie Li, Shu-lei Chou, Shi-xue Dou

Institute for Superconducting and Electronic Materials, Australian Institute for Innovative Materials, University of Wollongong, Squires Way, North Wollongong, NSW 2500, Australia.

*To whom correspondence should be addressed. E-mail: zhenl@uow.edu.au.

Contents

1. Figures

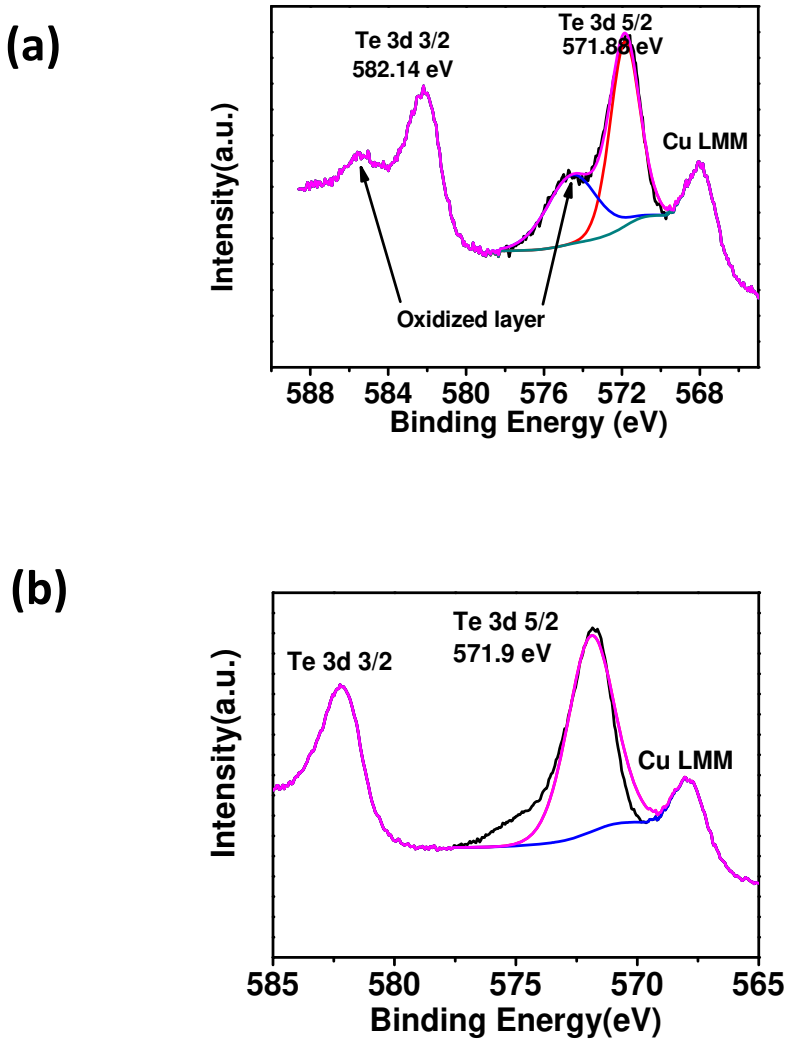


Figure S1. XPS spectra of Te 3d from (a) copper telluride nanocubes and (b) copper telluride nanosheets.

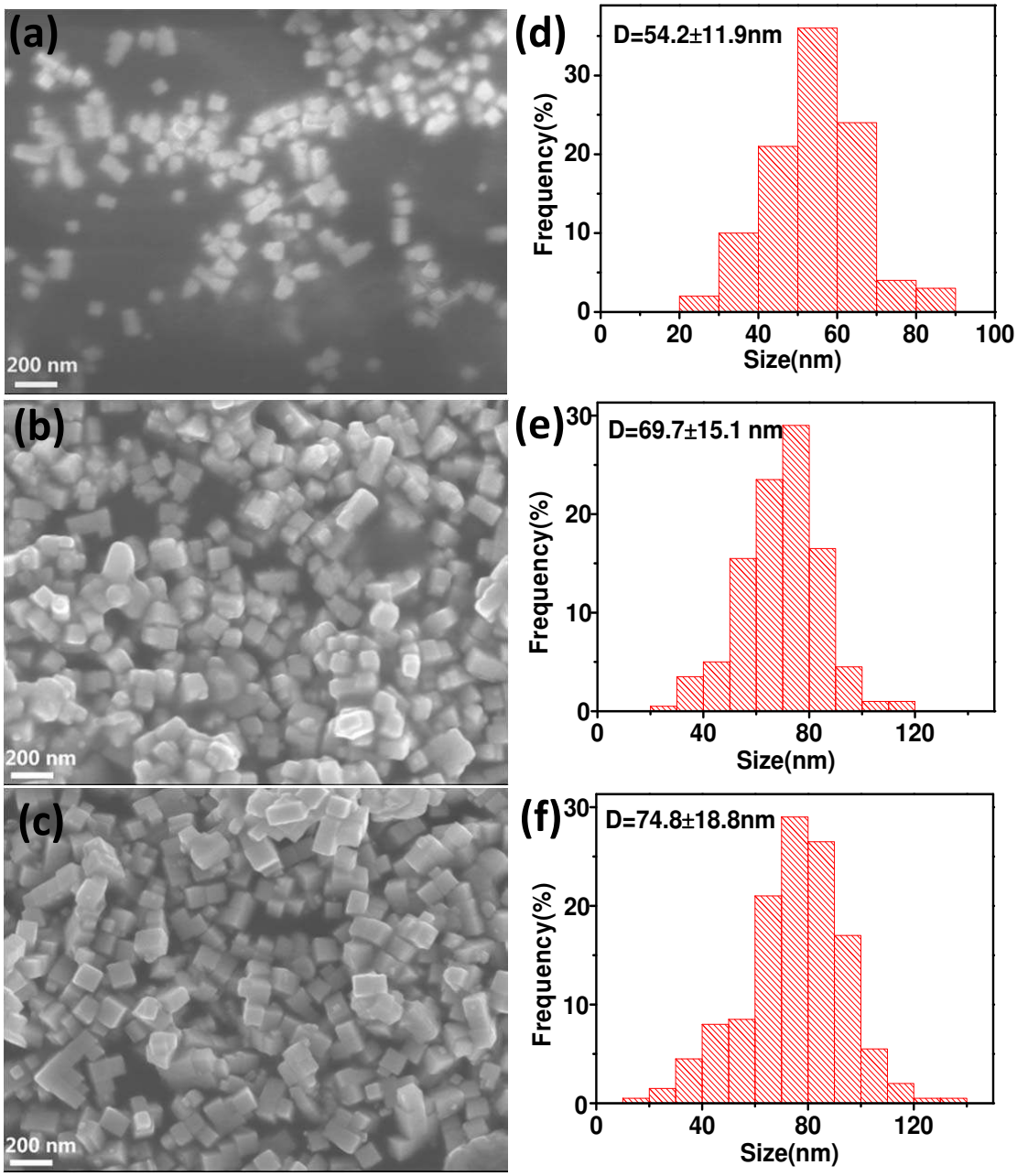


Figure S2 SEM images and size distributions of copper telluride nanocubes prepared from different reaction times: (a, d) 5min, (b, e) 6min, and (c, f) 8min.

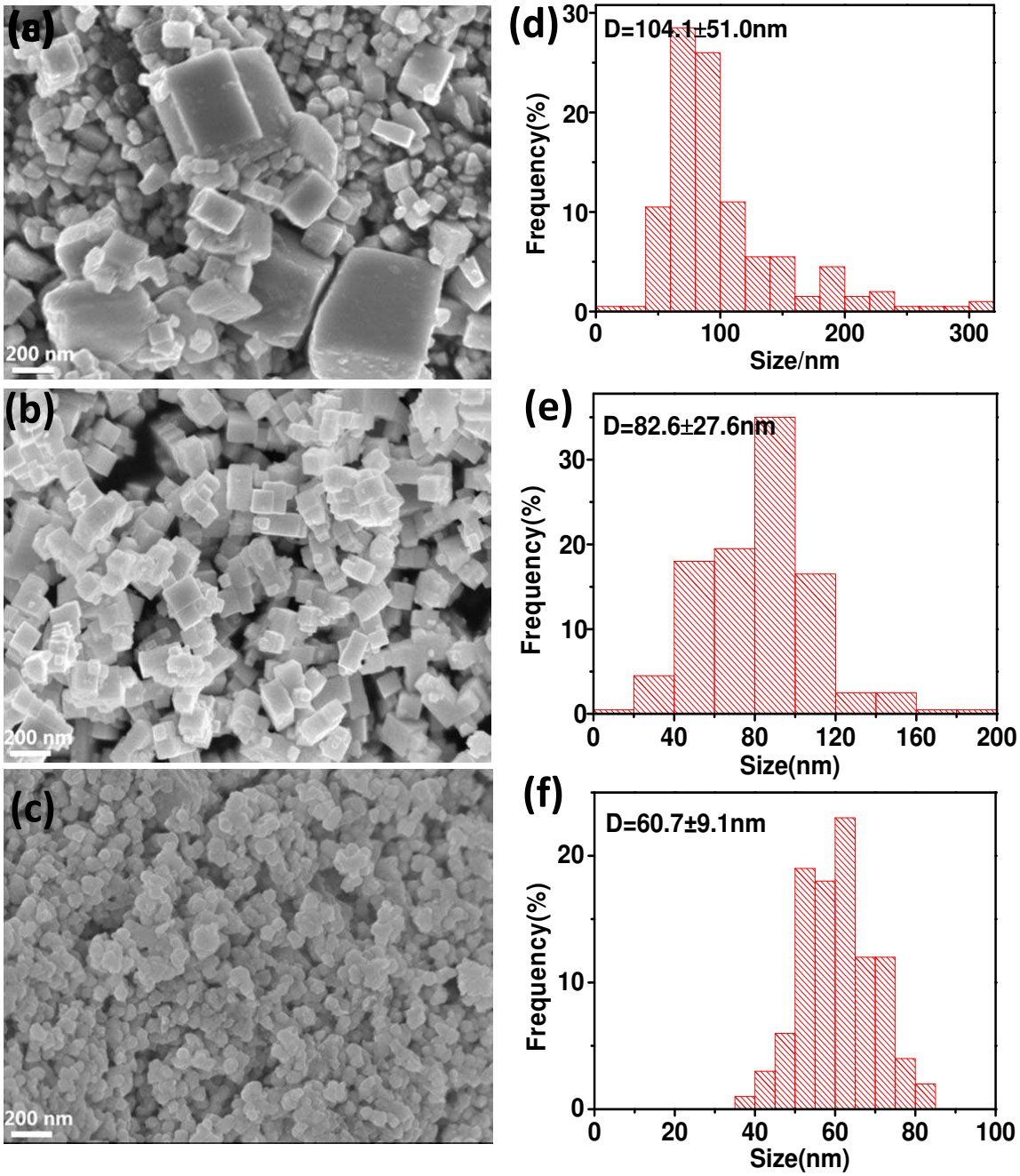


Figure S3 SEM images and size distribution of nanostructures prepared using different CuCl concentrations at 250 ℃: (a, d) 0.2 M, (b, e) 0.05 M, and (c, f) 0.01M.

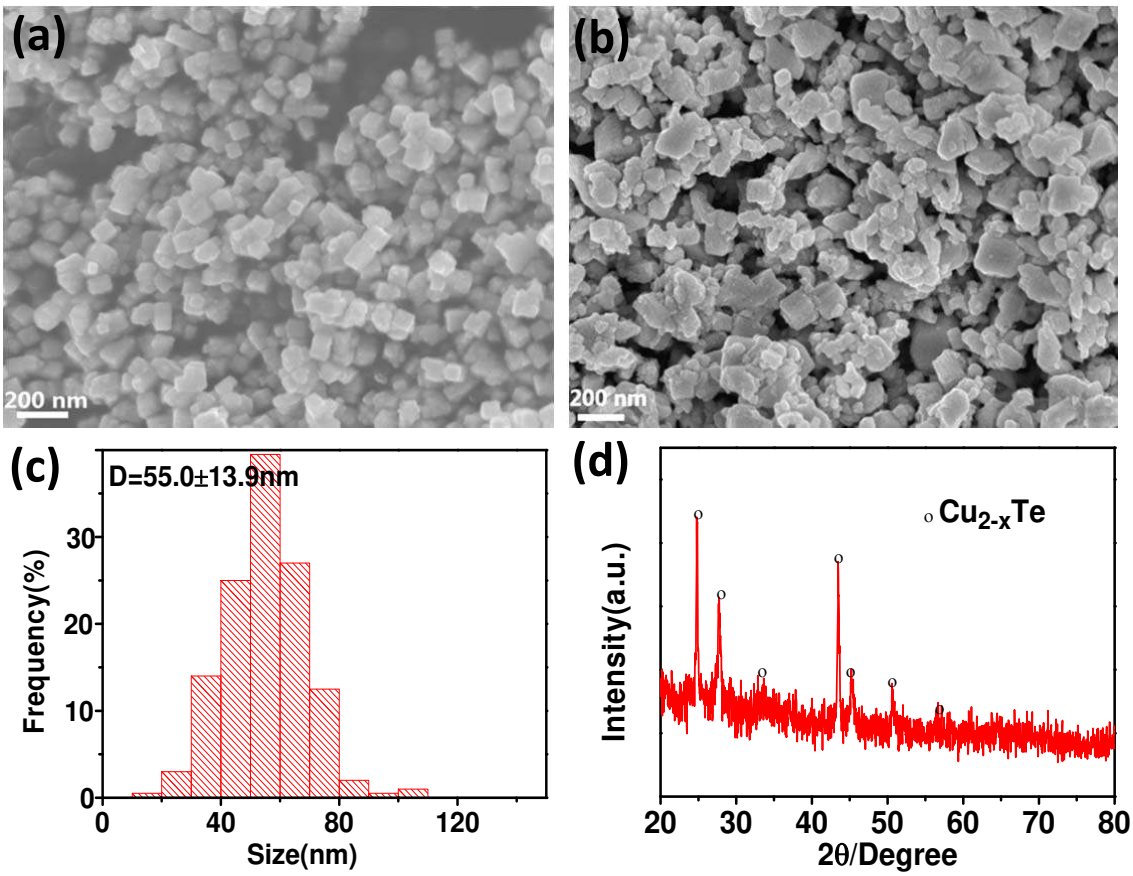


Figure S4 (a-b) SEM images of samples prepared at 230 ℃ and 270 ℃using 0.02 M CuCl; (c) size distribution of sample prepared at 230 ℃; (d) XRD pattern of sample prepared at 270 ℃.

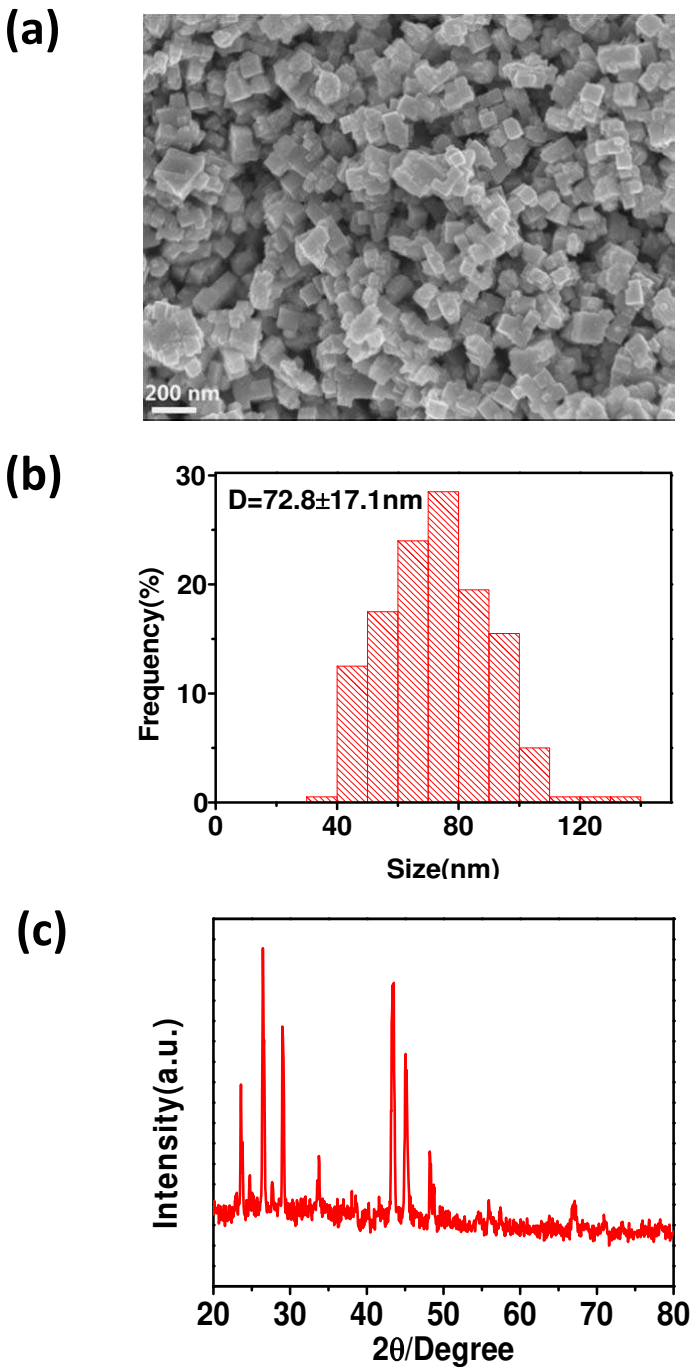


Figure S5 (a) SEM image, (b) size distribution and (c) X-ray diffraction pattern of copper telluride nanocubes synthesised with a ratio of 10 (CuCl/TOPTe).

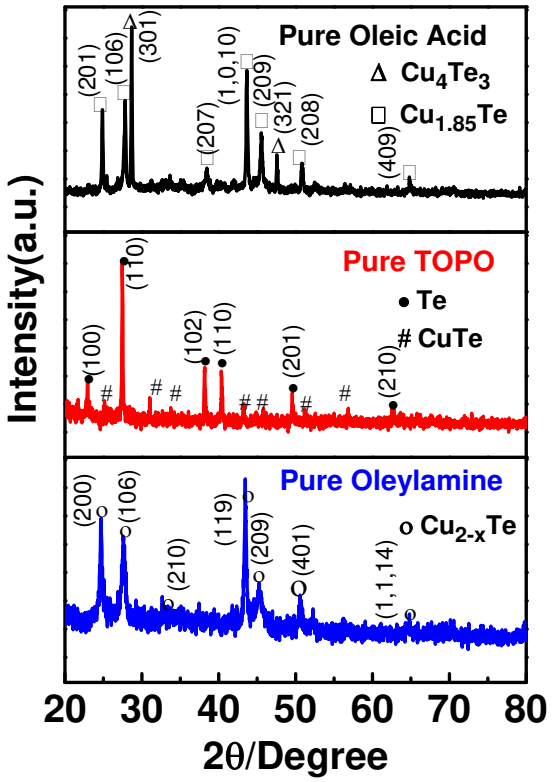


Figure S6 XRD patterns of samples prepared in oleic acid, TOPO and oleylamine.

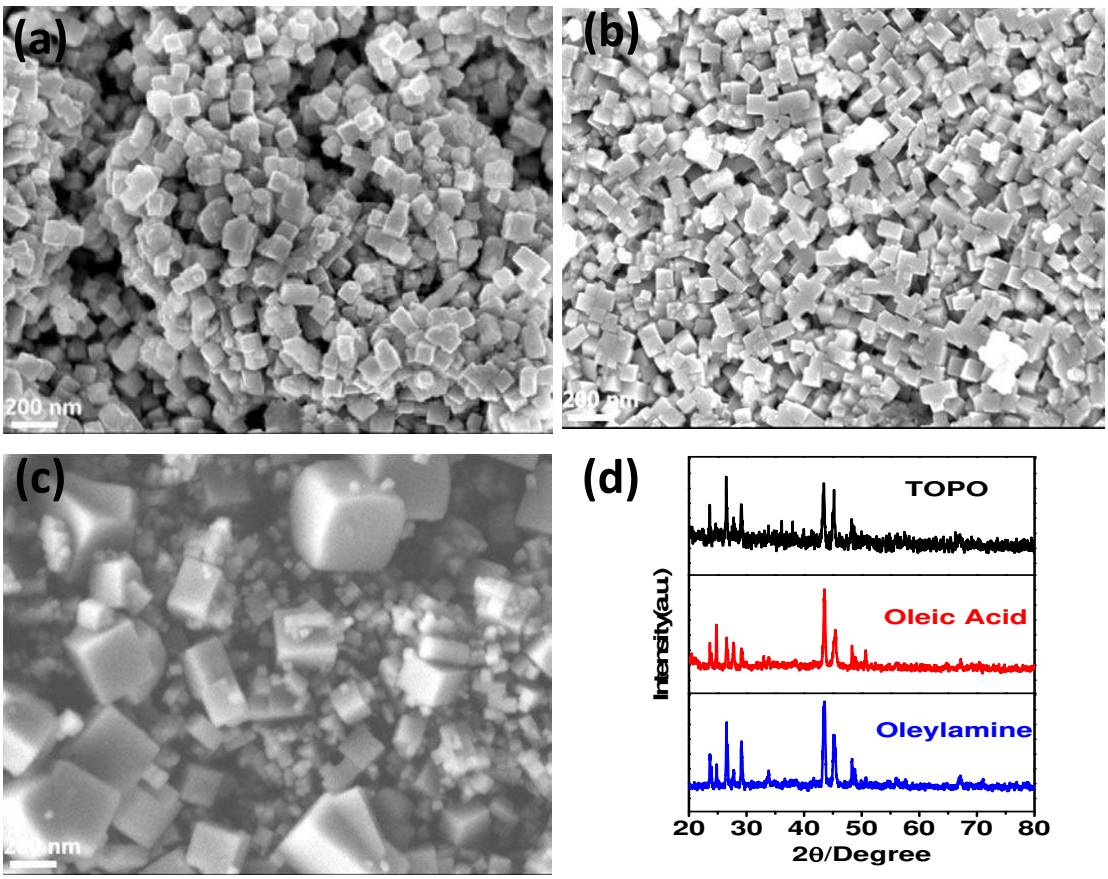
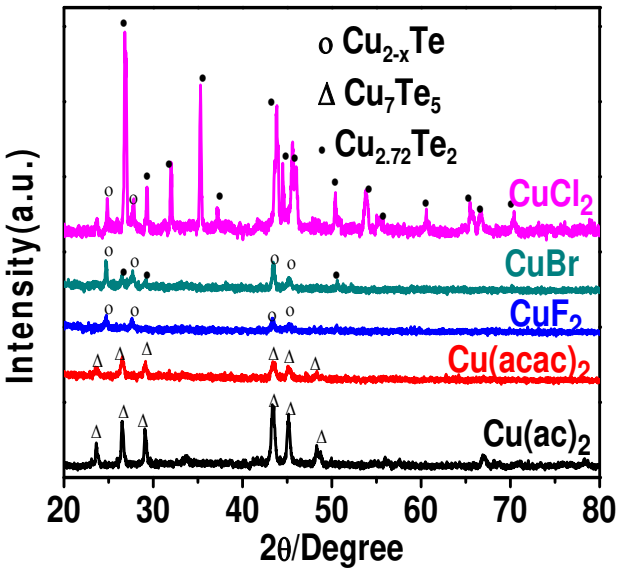
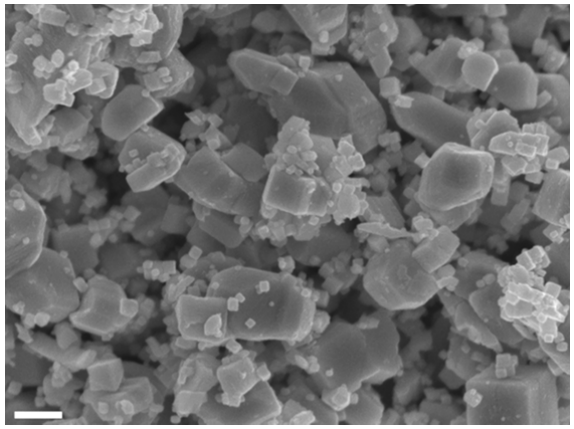


Figure S7 SEM images and XRD patterns of nanocubes prepared by adding small amount of ligands into TOP: (a) oleylamine; (b) TOPO; (c) oleic acid.

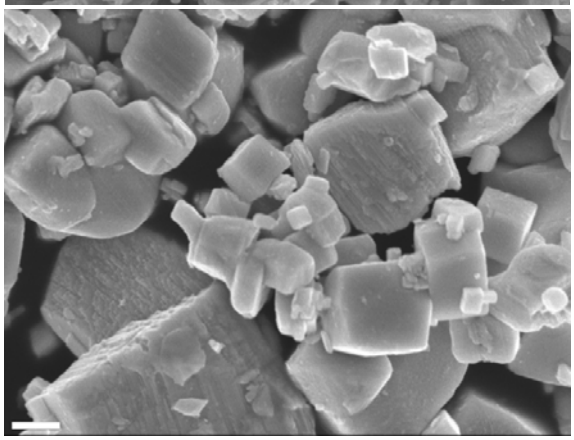
(a)


o Cu2-xTe
Δ Cu7Te5
. Cu2.72Te2
CuCl2
CuBr
CuF2
Cu(acac)2
Cu(ac)2
Intensity(a.u.)
20
30
40
50
60
70
80
2θ/Degree

(b)



(c)



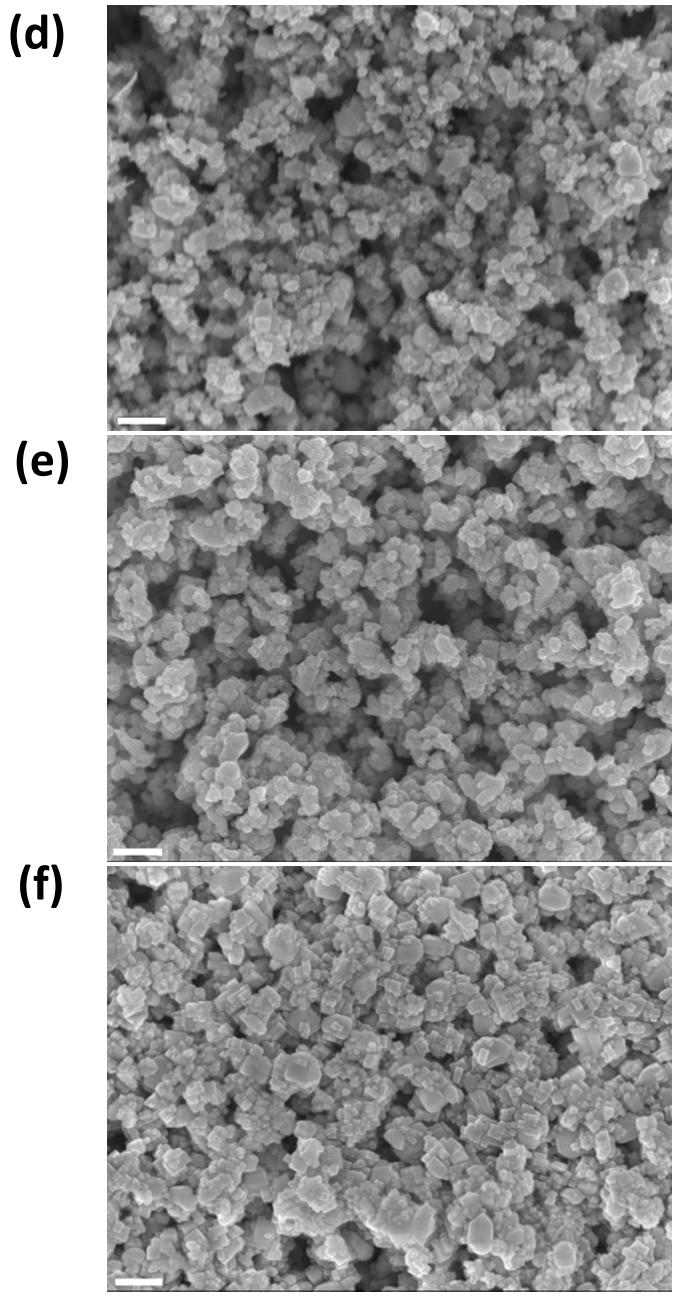


Figure S8 XRD and SEM images of samples prepared with different copper precursors. (a) XRD patterns; (b) CuBr; (c) $CuCl_2$; (d) CuF_2; (e) $Cu(CH_3COO)_2$; (f) $Cu(acac)_2$. All scale bars are 200 nm.

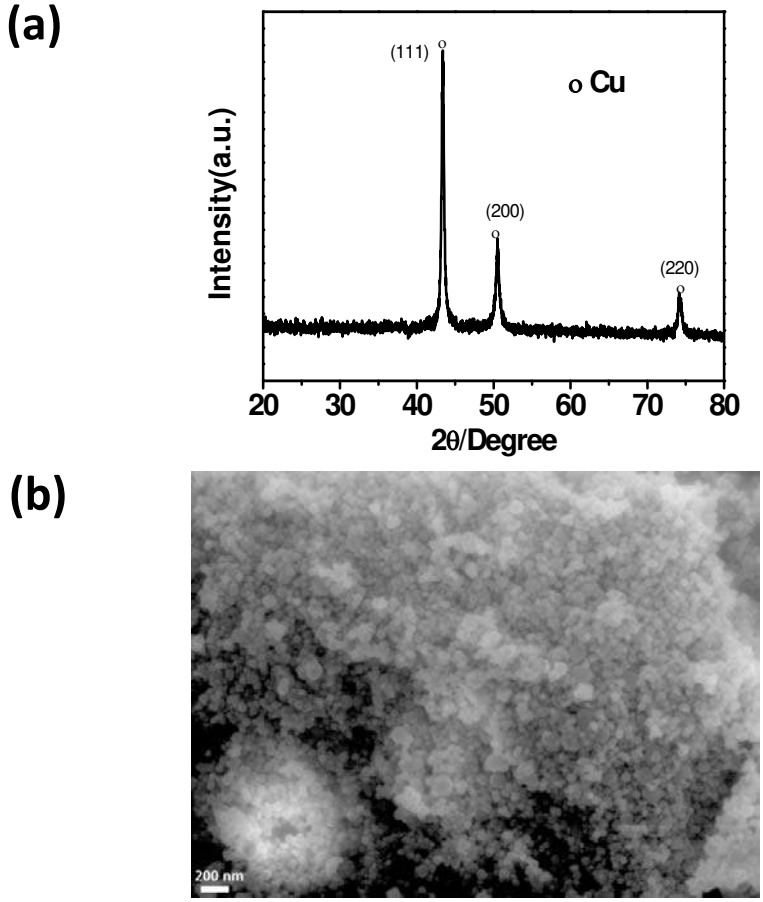


Figure S9 XRD and SEM image of precipitate obtained by heating CuF_2 in TOP at 250 ℃ for 10 min.

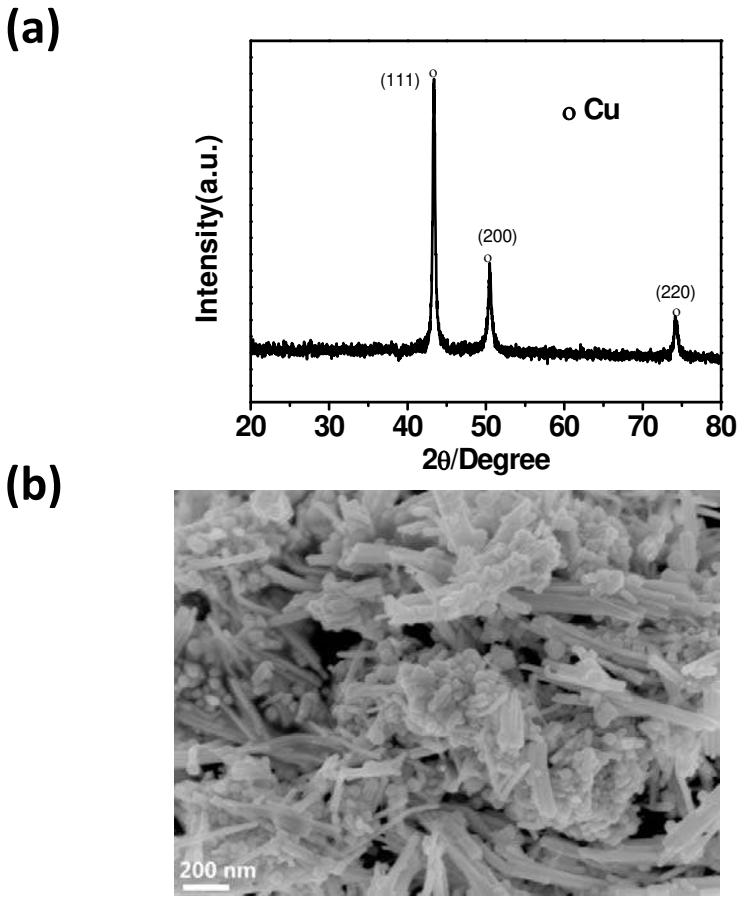


Figure S10 XRD and SEM image of product obtained by heating CuCl in oleylamine at 250 ℃ for 10 min.

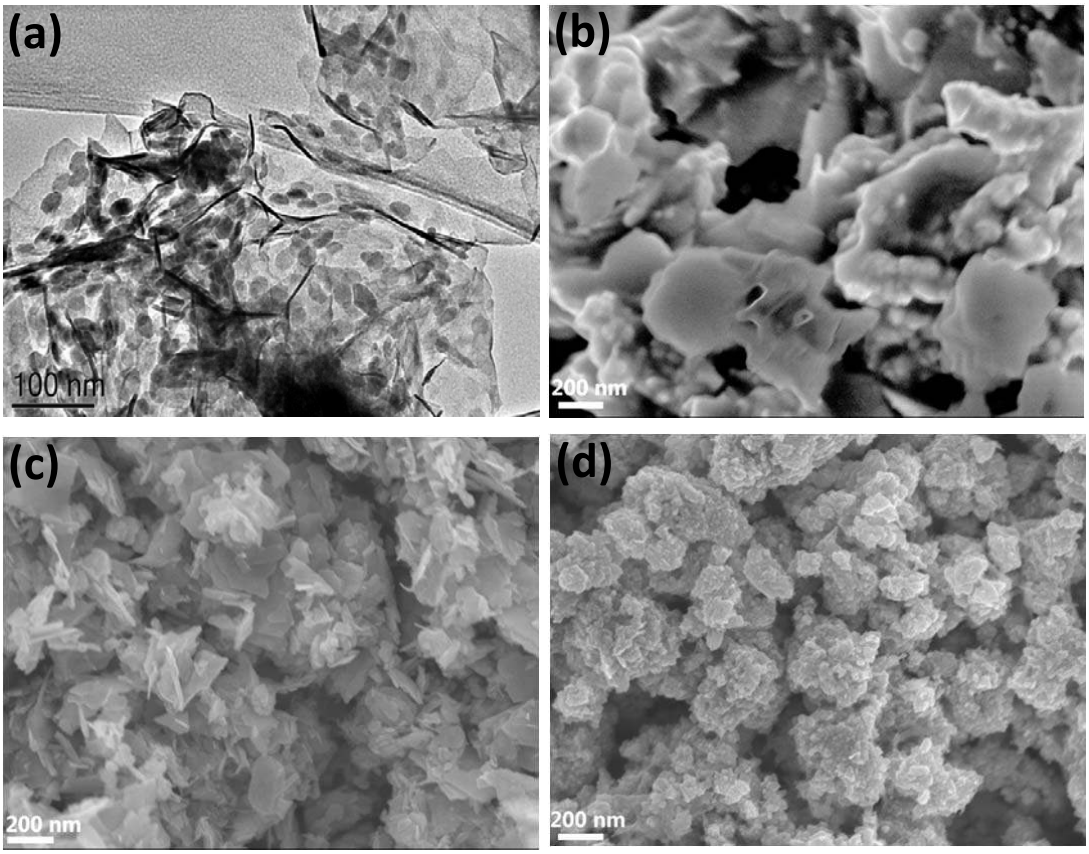


Figure S11 Different $Cu_{2-x}Te$ sheet structure synthesised under different temperatures and CuCl concentrations. (a) TEM of sample synthesised with 0.02 M CuCl at 230 ℃; (b) sample obtained from 0.02 M CuCl at 270 ℃; (c) sample synthesised with 0.05 M CuCl at 250 ℃; (d) sample synthesised with 0.005 M CuCl at 250 ℃.

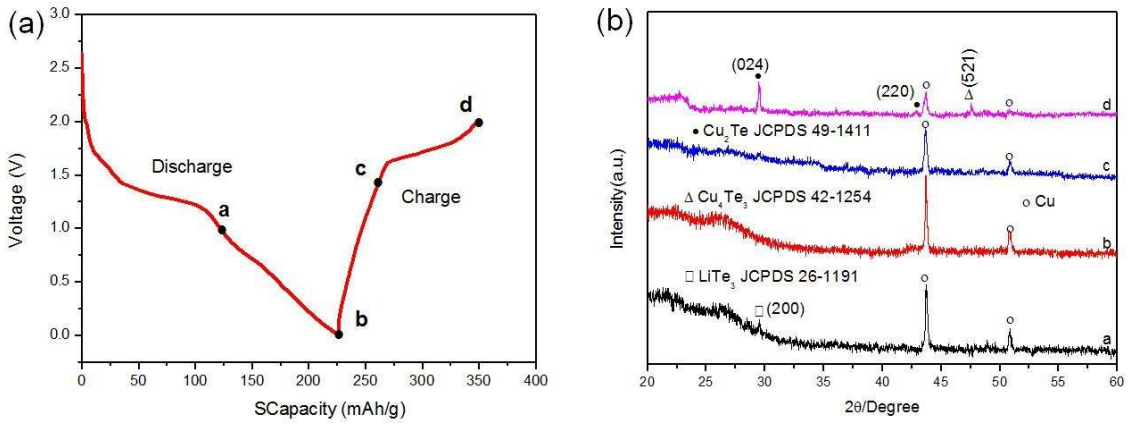


Figure S12 Ex-situ XRD for Cu2-xTe electrodes stopped at different voltage plateaus: (a) voltage state of the plateaus; (b) ex-situ XRD for the 4 electrodes.

2. Synthesis of hollowed $Cu_{2-x}Te$ nanoparticles.

In order to investigate the effect of materials shapes on battery performance, hollowed $Cu_{2-x}Te$ nanoparticles were synthesised as followed: $Cu(acac)_2$ (0.25 mmol), HDA (4.18 g), and TOP (2 ml) were loaded into a 100 ml three neck flask. After being degassed at 100 ℃ for 30 min, the mixture was heated to 250 ℃ under protection of Ar and a yellow copper precursor solution formed. The solution was kept at 250 ℃ for 10 min to let the temperature stable and the solution changed into brown, 125 μl, 1 M TOPTe solution was swiftly injected into the copper precursor. The temperature of the copper precursor decreased no more than 1 ℃ and was kept at 250 ℃ for another 10 min, the solution turned into black. The product was purified by repeatedly precipitating and re-dispersing in ethanol and dichloromethane, respectively.