# Supporting Information

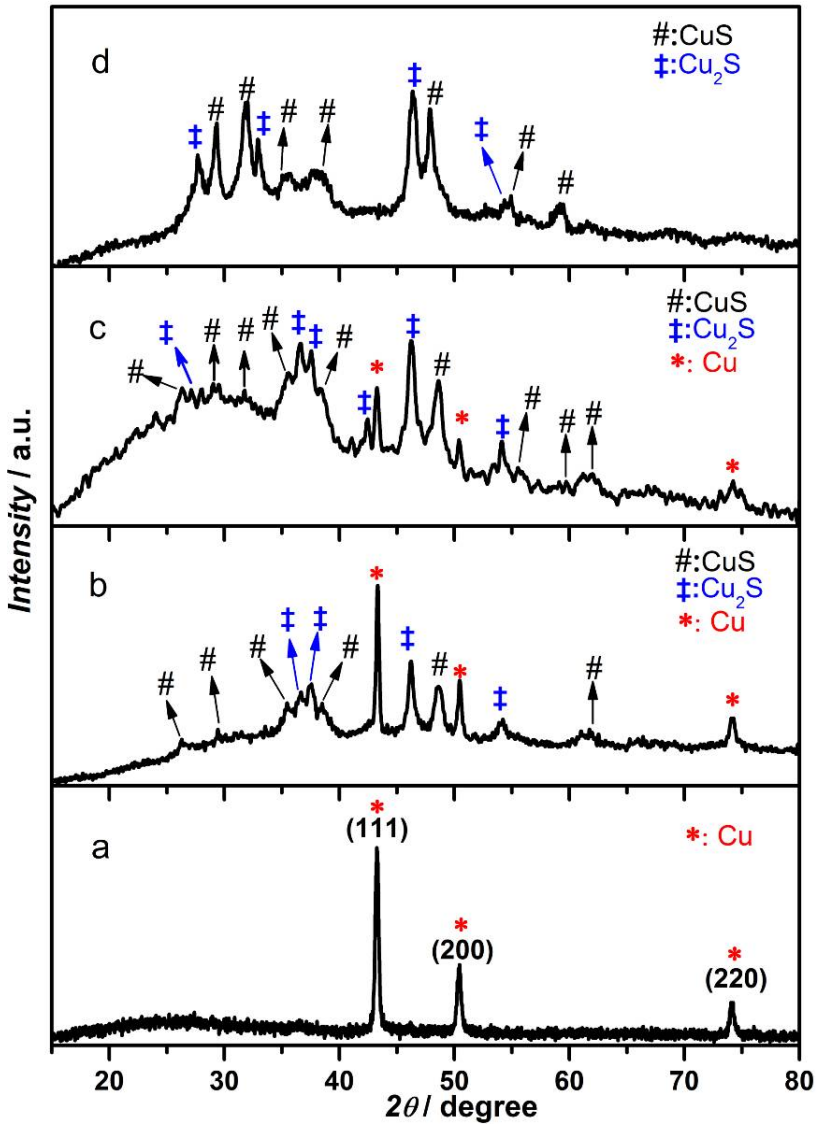


**Figure S1** XRD patterns of the corresponding samples: (a) Cu nanowires, (b) the S-30 sample, (c) the S-60 sample, and (d) the S-120 sample.

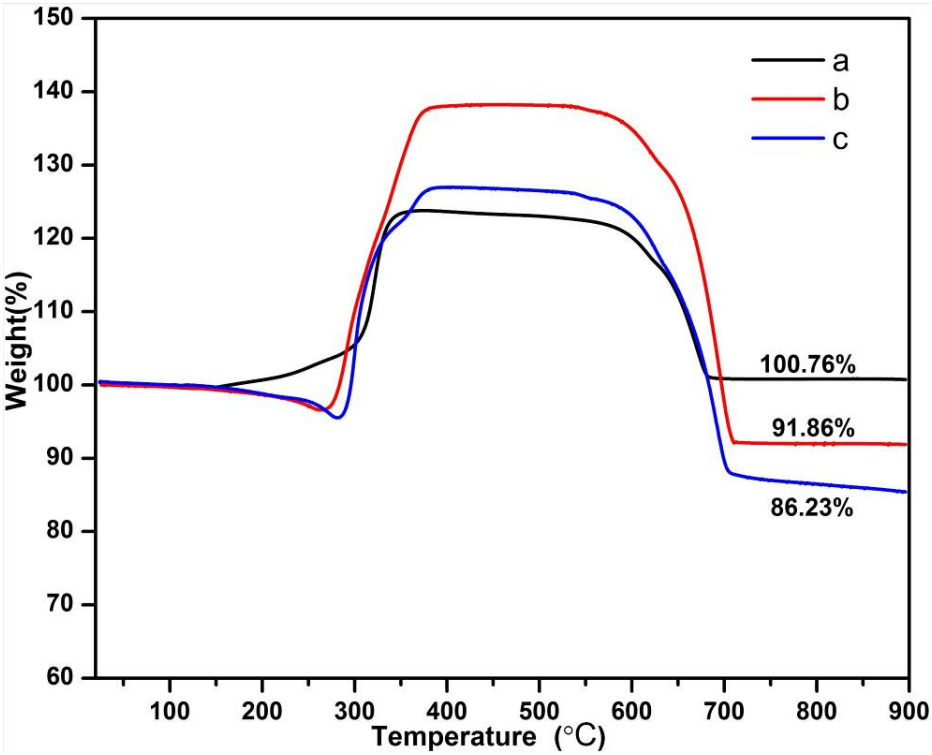


**Figure S2** TGA of the as-prepared samples: (a) the S-30 sample, (b) the S-60sample and (c) the S-120 sample. The TGA analysis is carried out in air at a heating rate of 10 K $min^{-1}$.

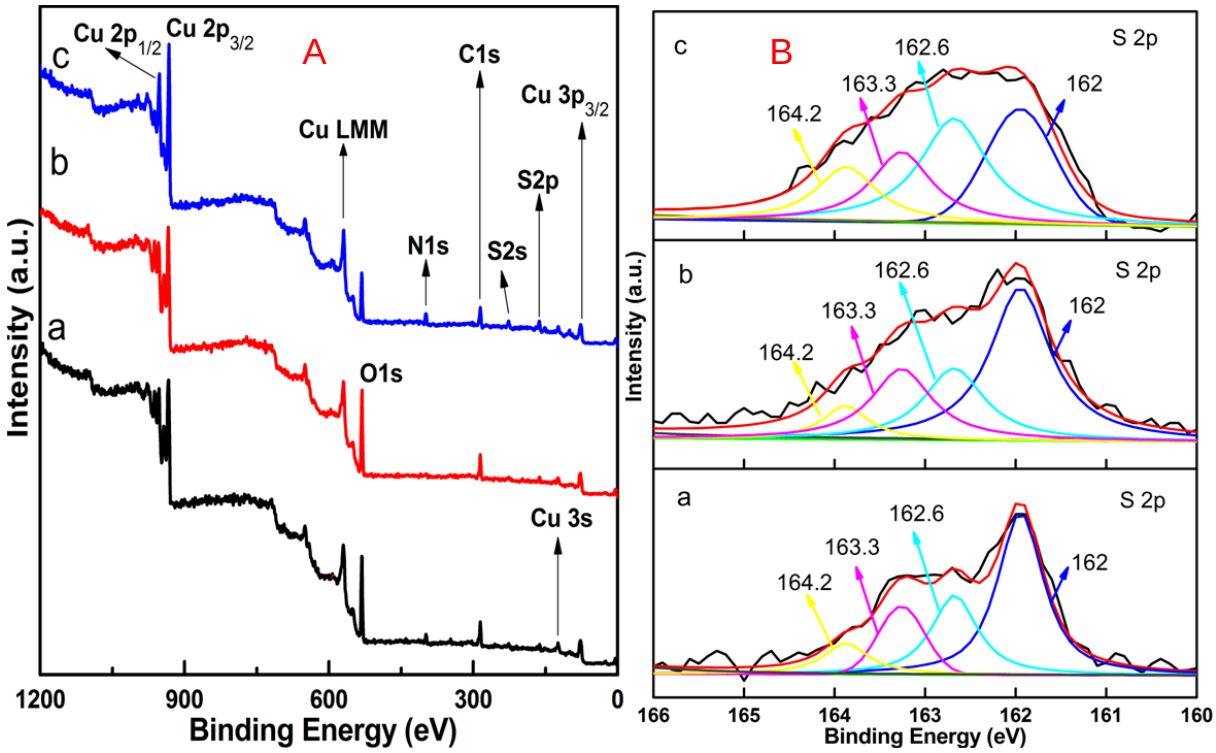


**Figure S3** XPS spectra of as-prepared samples: (A) The XPS survey spectra, (B) S 2p photoelectron spectra of the S-30 sample (a), the S-60 sample (b), and the S-120 sample (c).

Part A shows wide-scan spectra of the three samples. The spectra of the S-30, S-60 and S-120 samples show peaks at 932eV ( Cu 2p3/2) , at 952 eV (Cu 2p1/2) and at 162 eV (S2p) which are in agreement with the previous reports[1,2,3]. In part B, the S 2p spectrum of the three samples was fitted into two pairs of S 2p3/2 and S 2p1/2 doublets. The first pair located at 162 eV and 162.6 eV are attributed to surface tangling sulfur anions, and the second pair located at 163.3 eV and 164.2 eV are assigned to the lattice sulfur of CuS in the surface region[4, 5].

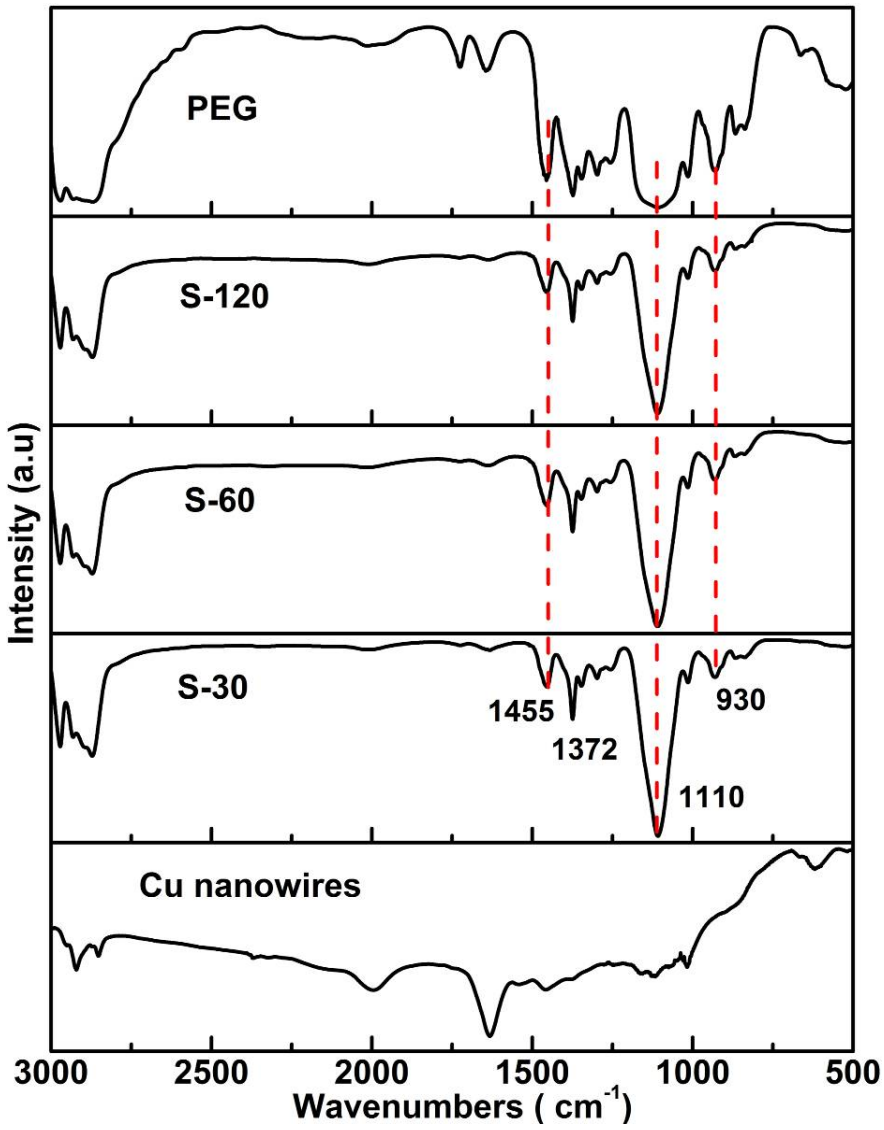


**Figure S4** FTIR spectra of the as-prepared samples. From the FTIR spectra of the S-30, S-60, S-120 samples, there are four peaks associated with the PEG: the main absorption band at 1455 $cm^{-1}$ is dominated by the $CH_2$- scissoring modes of the ether unites; the strong absorption band at 1110 $cm^{-1}$ is attributed to the C-O-C stretching vibration; 1372 $cm^{-1}$ and 930 $cm^{-1}$ are associated with the ether $CH_2$-wagging and rocking modes[6,7].

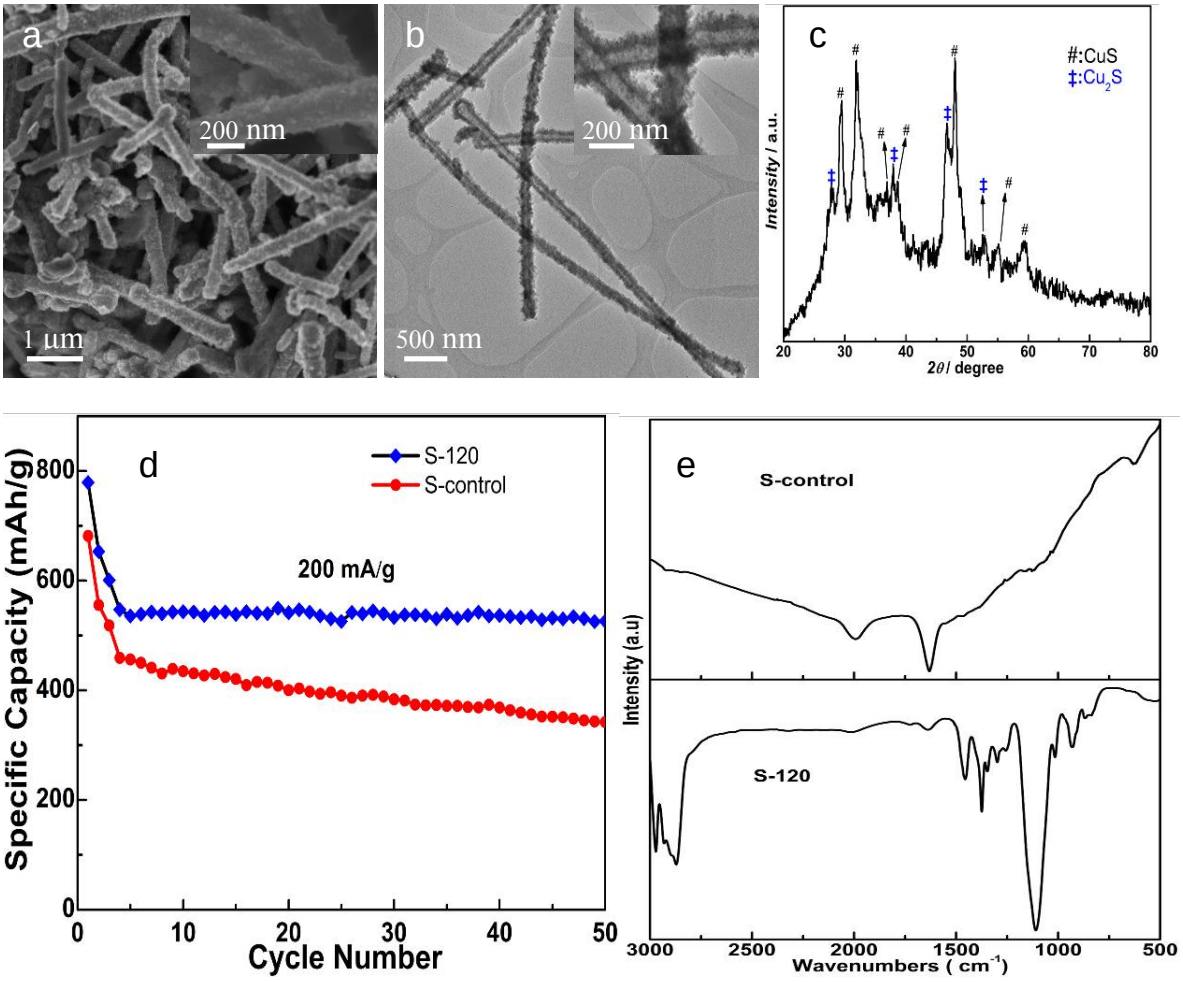


**Figure S5** (a) SEM images; (b) TEM images; (c) XRD patterns of the S-control ($Cu_xS$ nanotubes) prepared in ethanol. (d) Cycling performance of the S-120 sample and $Cu_xS$ without PEG at a current density of 200 mA $g^{-1}$ within a voltage window of 0.001-3.0V; (e) FTIR spectra of the S-120 sample and S-control sample.

(Note: the preparation of the S-control sample: 10.57mg of Cu nanowires was dispersed in a mixture of 45 ml ethanol (99.9%) under stirring in a three-neck flask. Then, 1.5 ml ethanol solution containing 9.84 mg thiourea was added. The flask was then sealed by rubber septums and purged with argon for 15min. The mixed solution was sealed into a 50 mL Teflon autoclave (actual volume of the autoclave about 46.4ml) and maintained at 180 ℃ for a period

of 120 minute. The autoclave was cooled down rapidly using tap water. The final products were washed several times by acetone and ethanol followed by centrifugation at 6000 rpm for 5 min several times and finally dispersed in ethanol for further characterization.)

Tables:

Table S1 Binding energy (eV) of Cu $2p_{3/2}$ for different $Cu_xS$/Cu samples

| | S-30 | | | S-60 | | | S-120 | |
|---|---|---|---|---|---|---|---|---|
| Peaks | $Cu^{2+}$ | $Cu^{1+}$ | $Cu^0$ | $Cu^{2+}$ | $Cu^{1+}$ | $Cu^0$ | $Cu^{2+}$ | $Cu^{1+}$ |
| BE(eV) | 934.1 | 932.1 | 932.4 | 934.3 | 932.2 | 932.4 | 934.2 | 932 |
| Area | 13187.4 | 5255.4 | 1000.5 | 10655.3 | 9739.3 | 541 | 11649.3 | 12392.2 |
| $Cu^{2+}/Cu^{1+}$ | 2.51 | | | 1.09 | | | 0.94 | |
| Cu ($Cu^{2+}$ + $Cu^{1+}$ ) : S | 1.16 | | | 1.31 | | | 1.34 | |

Table S2 the amount for different $Cu_xS$/Cu samples by TGA

| | S-30 | | S-60 | | S-120 |
|---|---|---|---|---|---|
| | $Cu_xS$ | $Cu^0$ | $Cu_xS$ | $Cu^0$ | $Cu_xS$ |
| Wt (%) | 67.68 | 32.32 | 90.02 | 9.98 | 100 |

Supporting Reference:


1. Teo, J. J.; Chang, Y.; Zeng, H. C., Fabrications of Hollow Nanocubes of $Cu_2O$ and Cu via Reductive Self-Assembly of CuO Nanocrystals. *Langmuir* **2006,** *22* (17), 7369-7377.
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3. Huang, L.; Peng, F.; Yu, H.; Wang, H., Preparation of cuprous oxides with different sizes and their behaviors of adsorption, visible-light driven photocatalysis and photocorrosion. *Solid State Sciences* **2009,** *11* (1), 129-138.
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