

Supplementary Information:

Different experimental parameters, the molar ratio of sulphur and $\text{Cu}(\text{TFSI})_2$ concentration, reaction time and temperature were optimized to obtain CuS thin films. The following figure shows the effects of these experimental parameters on the formation of CuS films.

Figure SI XRD patterns and SEM images of CuS films prepared in [EMIm]TFSI bath under different conditions: (a) different mass ratios for $\text{Cu}(\text{TFSI})_2$ and S_8 : 1:0.5, 1:1, 1:2 and 1:10 ($T=120^\circ\text{C}$; $t=1\text{h}$); (b) different reaction times: 30min, 60min, 90min and 4h ($\text{Cu}(\text{TFSI})_2$: $\text{S}_8=1:2$; $T=120^\circ\text{C}$); (c) different temperatures: 120°C , 150°C , 180°C and 200°C ($\text{Cu}(\text{TFSI})_2$: $\text{S}_8=1:2$; $t=60\text{min}$).

