Supporting information

The K_{sp} gap enabled precipitation transformation reactions from transition metal hydroxides to sulfides for alkali metal ion storage

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Contents: Fig. S1–S5; Table S1

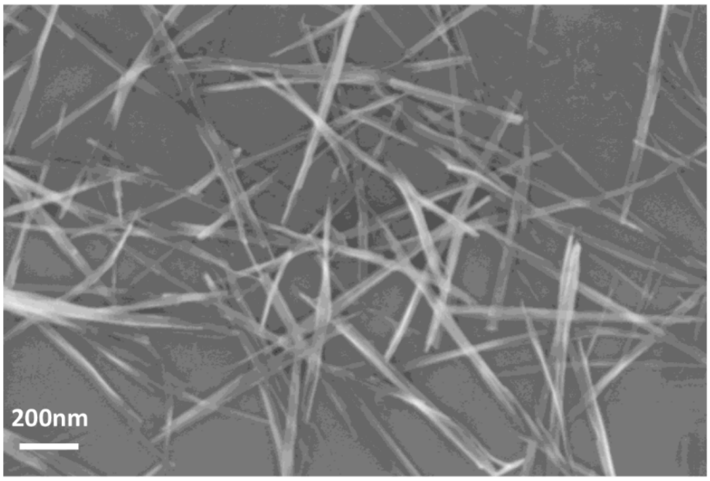

Fig. S1. Scanning electron microscope (SEM) image of $Cu(OH)_2$ nanowires.

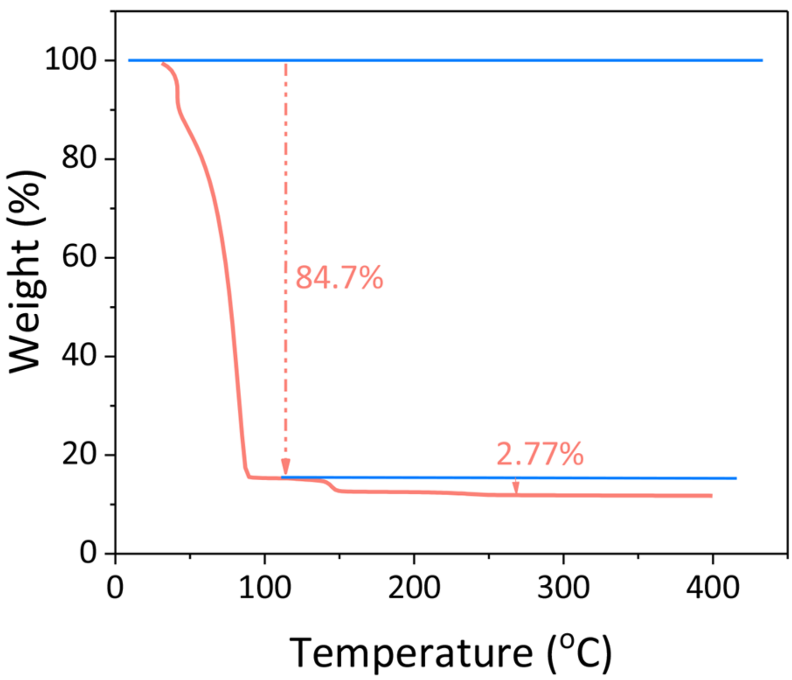

Fig. S2. Thermogravimetric (TG) curve of $Cu(OH)_2$ nanowires.

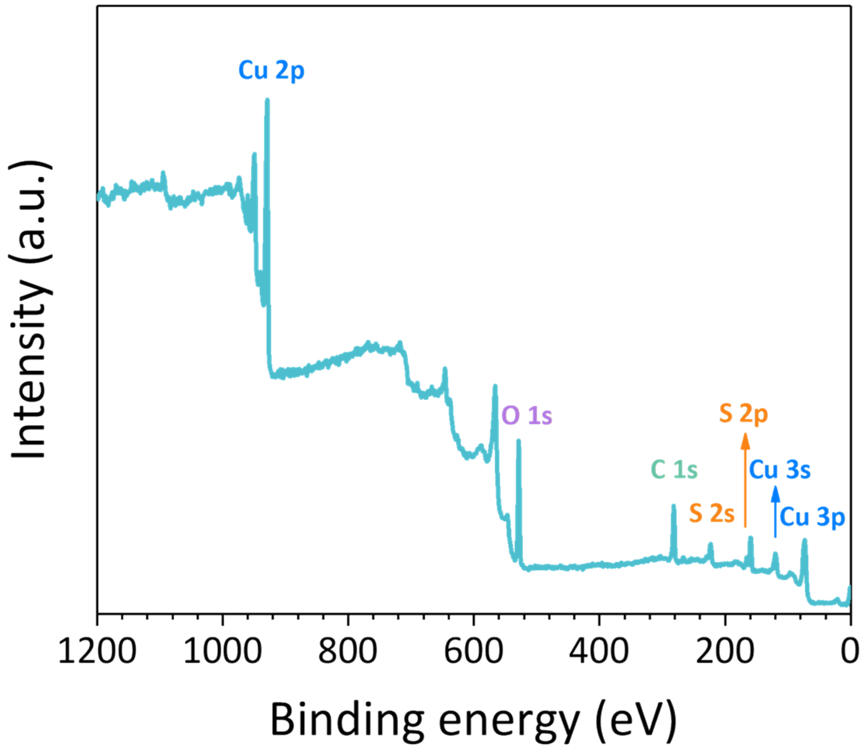

Fig. S3. X-ray photoelectron spectroscopy (XPS) curve of the CuS nanomaterial derived from $Cu(OH)_2$ nanowires.

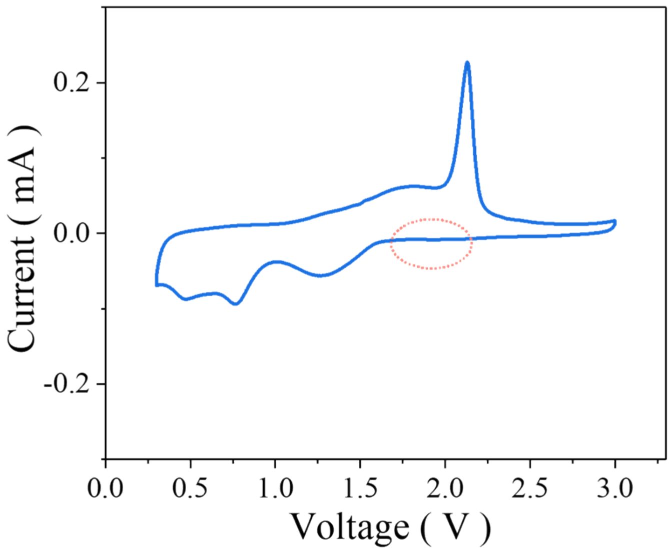

Fig. S4. CV curve for the fifth cycle of the SIB at a sweep rate of 0.1 mV s^{-1}.

Table S1. The chemical reaction equations corresponding to the redox peak of the cyclic voltammetry curves for the alkali metal ion batteries.

		Peak voltage		Redox equation	Process
		1st cycle	2nd cycle		
reduction peak	SIB	1.91V	1.94	$CuS + yNa^+ + ye^- \rightarrow Na_yCuS$ ($y < 0.5$) (Irreversible reaction)	R1
		1.41V	1.41	$Na_yCuS + (x\text{-}y)Na^+ + (x\text{-}y)\ e^- \rightarrow Na_xCuS$ ($0.5 < x < 1$)	
		1.11	-	Formation of SEI film	
		0.73V	0.73	$2Na_xCuS + (2\text{-}2x)Na^+ + (2\text{-}2x)e^- \rightarrow Cu_2S + Na_2S$	R2
		0.41V	0.38	$Cu_2S + 2Na^+ + 2e^- \rightarrow 2Cu + Na_2S$	R3
	LIB	2.03V	2.08	$CuS + yLi^+ + xe^- \rightarrow Li_yCuS$	R1
		1.58V	1.60	$Li_yCuS + (x\text{-}y)Li^+ + (x\text{-}y)e^- \rightarrow Li_xCuS$	
		1.20V	1.24	$2Li_xCuS + (2\text{-}2x)Li^+ + (2\text{-}2x)\ e^- \rightarrow Cu_2S + Li_2S$	R2
		0.85V	0.85	$Cu_2S + 2Li^+ + 2e^- \rightarrow 2Cu + Li_2S$	R3
	PIB	1.76V	1.95	$CuS + xK^+ + xe^- \rightarrow K_xCuS$	R1
		1.20V	1.41		
		0.83	-	Formation of SEI film	
		0.51V	0.51	$K_xCuS + (2\text{-}x)K^+ + (2\text{-}x)e^- \rightarrow Cu + K_2S$	R3
Oxidation peak	SIB	1.79V	1.79	$2Cu + Na_2S \rightarrow Cu_2S + 2Na^+ + 2e^-$	O1
		2.13V	2.13	$Cu_2S + Na_2S \rightarrow 2Na_xCuS + (2\text{-}2x)Na^+ + (2\text{-}2x)e^-$	O2
	LIB	1.87V	1.87	$2Cu + Li_2S \rightarrow Cu_2S + 2Li^+ + 2e^-$	O1
		2.06V	2.06	$Cu_2S + Li_2S \rightarrow 2Li_xCuS + (2\text{-}2x)Li^+ + (2\text{-}2x)e^-$	O2
		2.28V	2.28	$Li_xCuS \rightarrow CuS + xLi^+ + xe^-$	O3
	PIB	1.44V	1.44	$Cu + K_2S \rightarrow K_xCuS + (2\text{-}x)K^+ + (2\text{-}x)e^-$	O1
		2.00V	2.04	$K_xCuS \rightarrow CuS + xK^+ + xe^-$	O3
		2.39V	2.45		

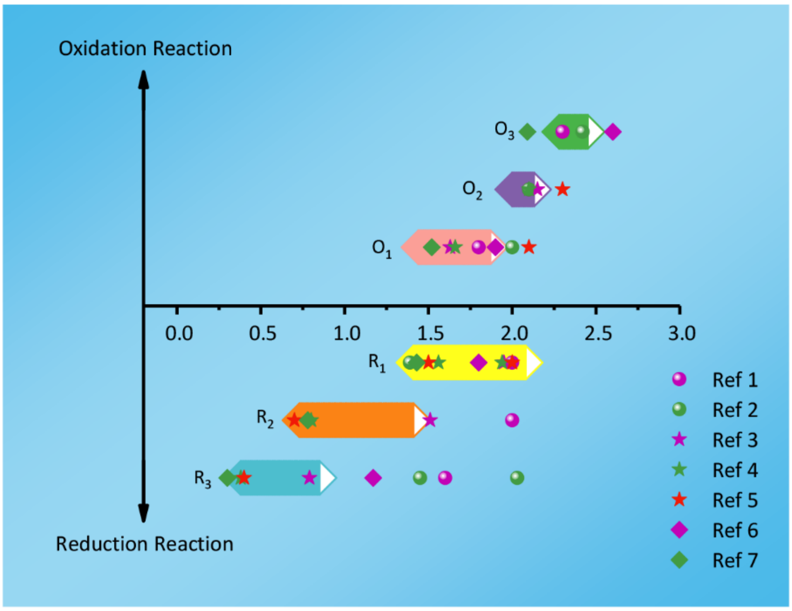

Fig. S5. Illustration of the peak voltage ranges for CuS storing Li^+, Na^+, or K^+ in literature.[1-7]

References

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