Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting information

Cu_3P as a novel cathode material for rechargeable aluminum-ion batteries

Gangyong Li, Jiguo Tu,* Mingyong Wang and Shuqiang Jiao*

*State Key Laboratory of Advanced Metallurgy, University of Science and Technology Beijing, 100083, P R China. * E-mails:guo15@126.com (J Tu), sjiao@ustb.edu.cn (S Jiao)*

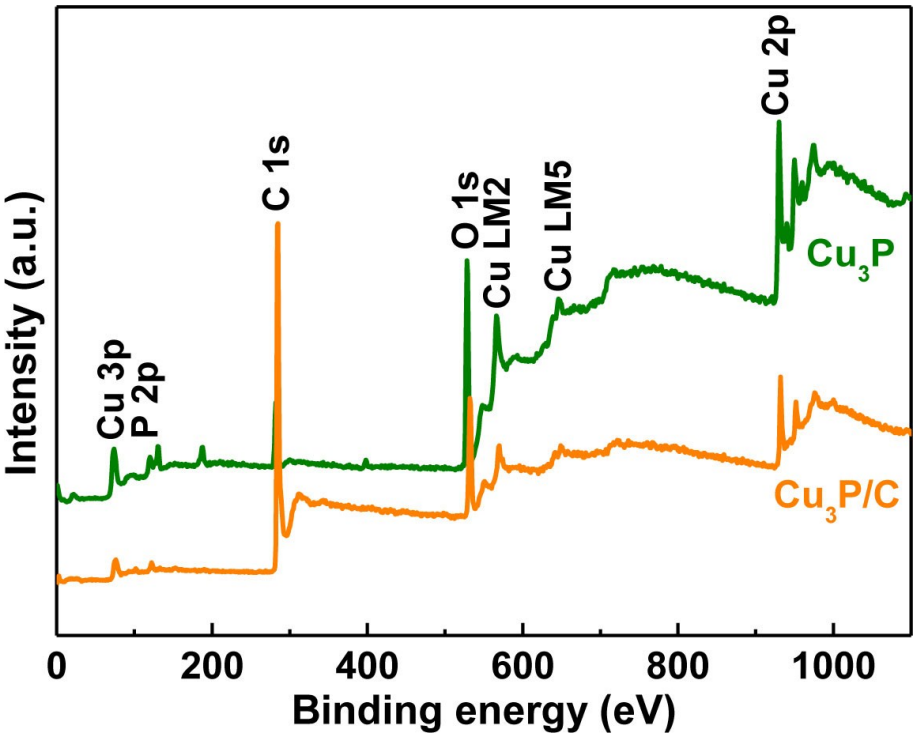

Fig. S1 XPS survey spectra of Cu_3P and Cu_3P/C composite.

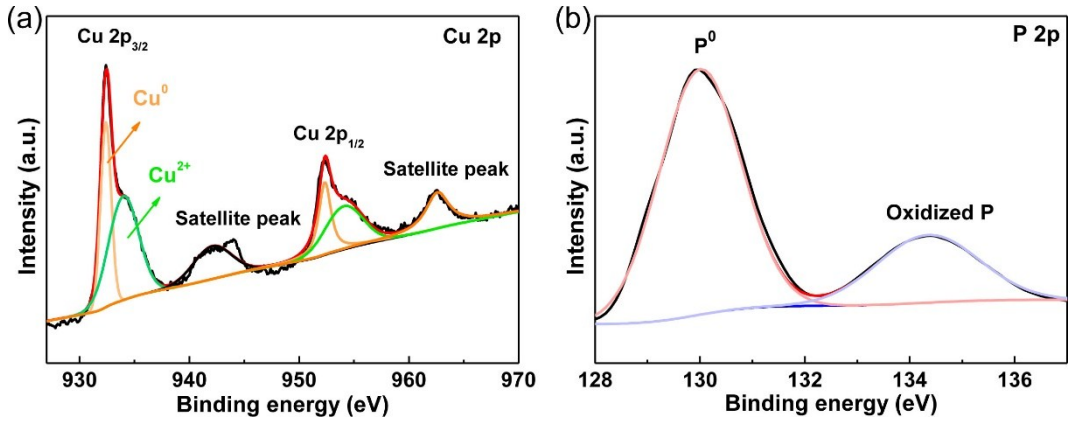

Fig. S2 (a) Cu 2p XPS spectrum of metallic Cu. (b) P 2p XPS spectrum of red P.

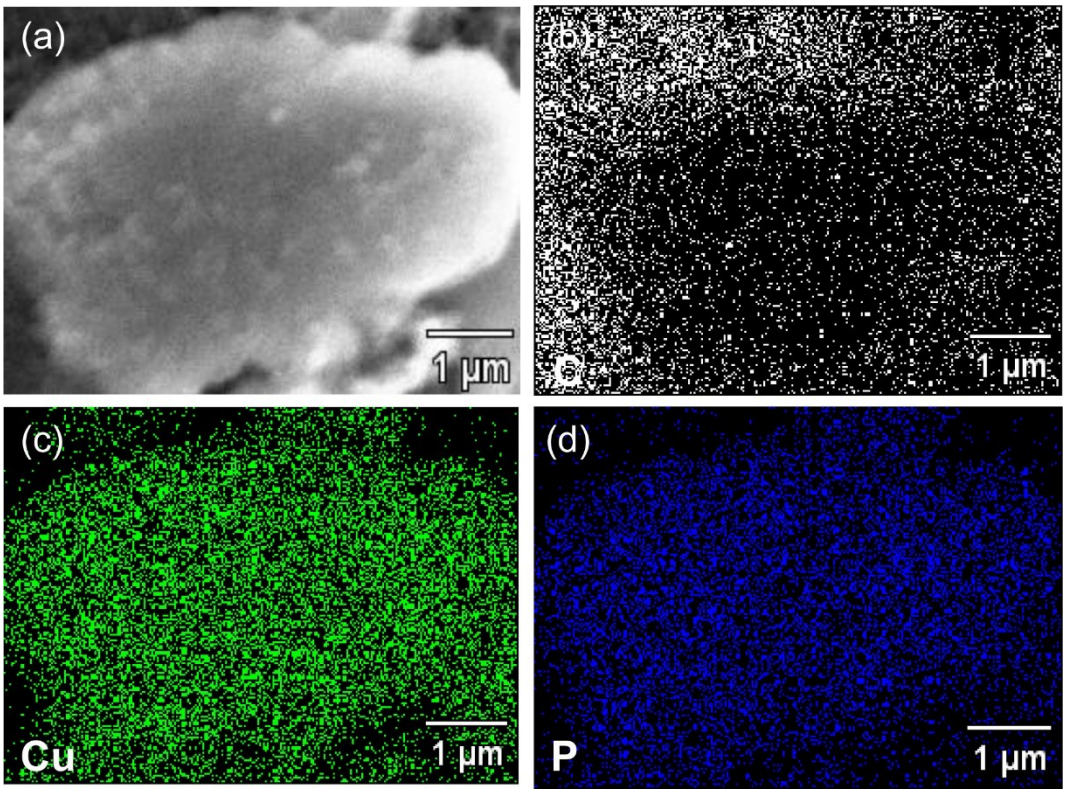

Fig. S3 SEM image (a) and the corresponding element mapping images of C (b), Cu (C) and P (d) for Cu_3P/C composite.

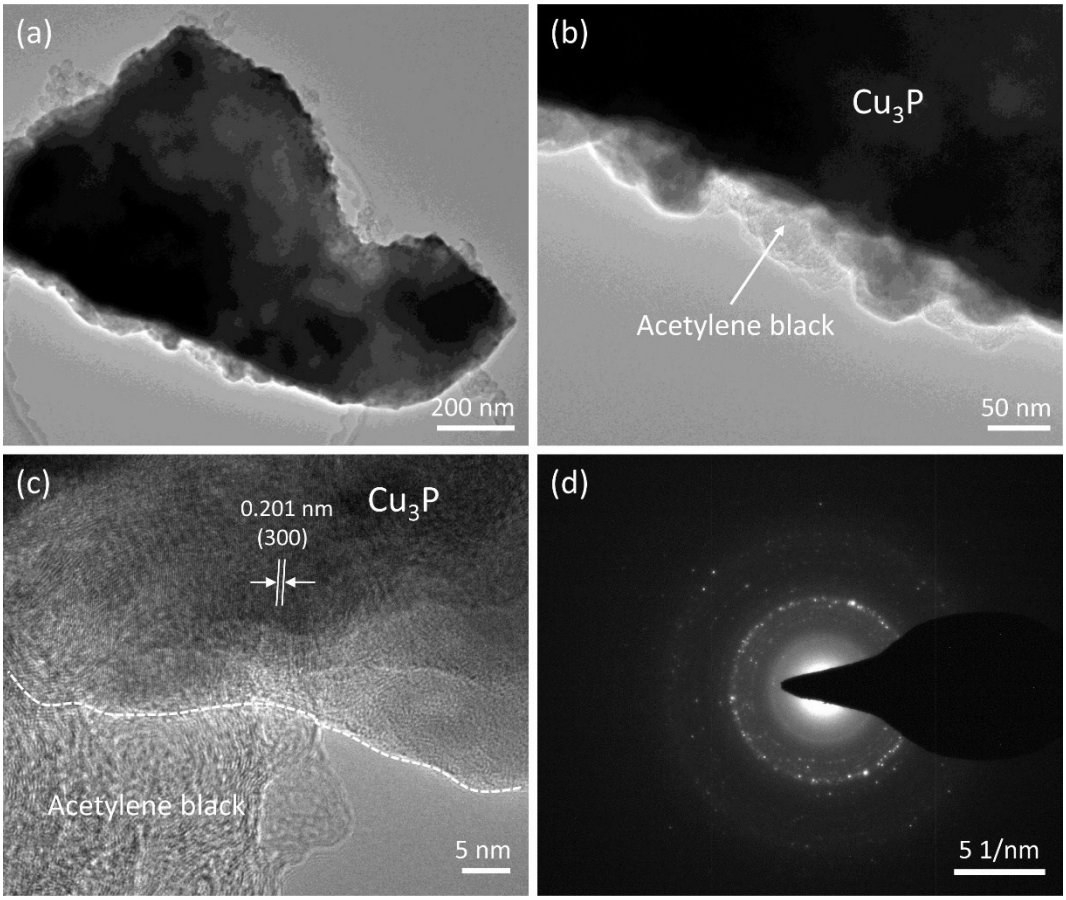

Fig. S4 (a and b) TEM, (c) HRTEM images and (d) SAED pattern of Cu_3P/C.

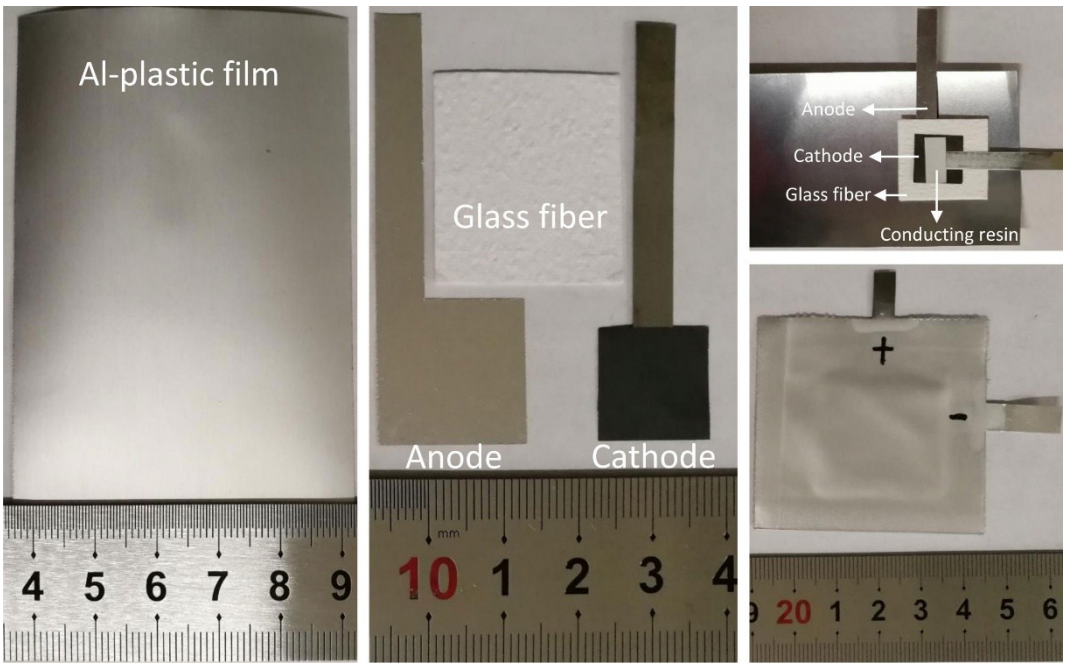

Fig. S5 Digital photographs showing the materials required for battery assembly.

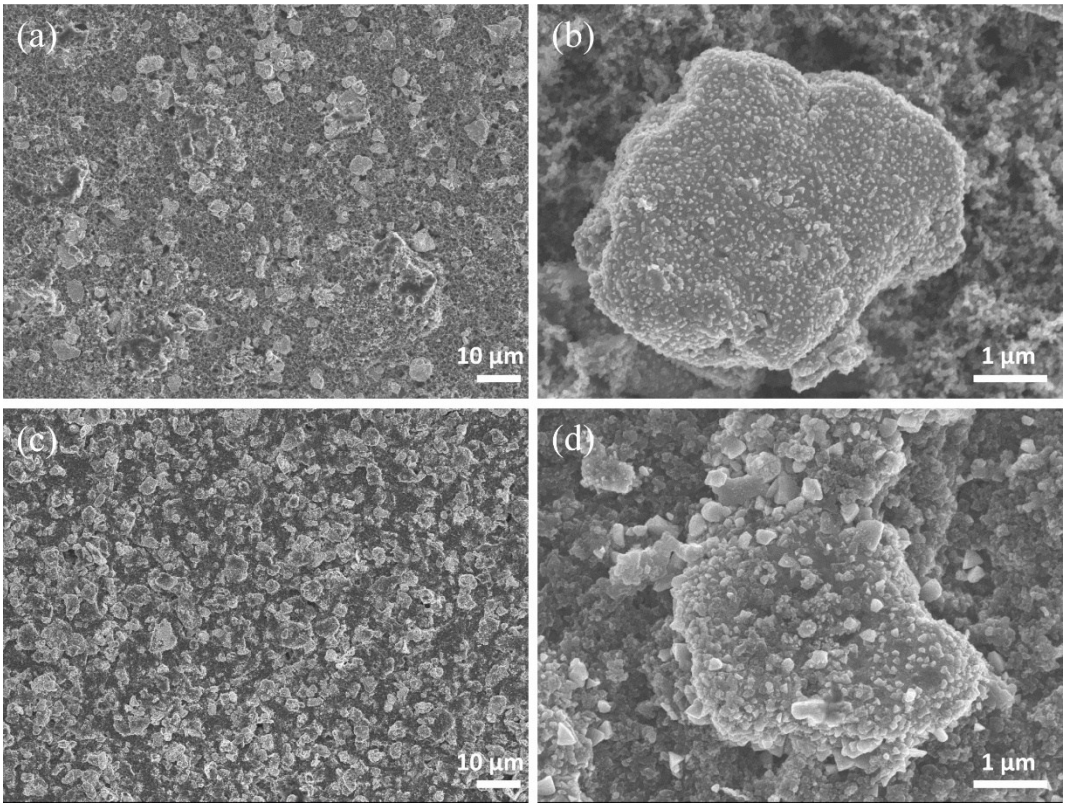

Fig. S6 SEM images of Cu_3P (a and b) and Cu_3P/C (c and d) electrodes.

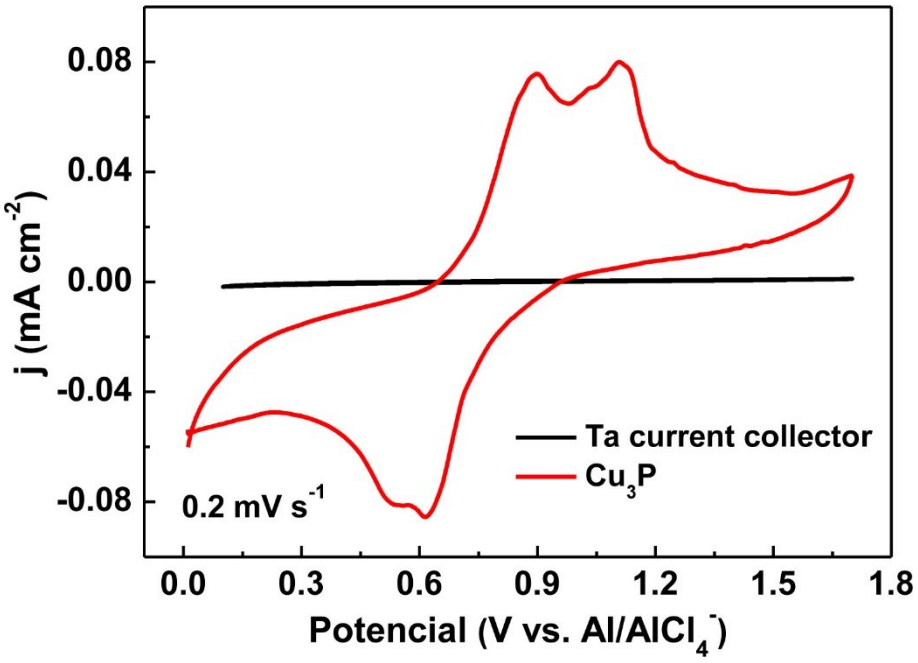

Fig. S7 CV curves of Ta current collector and Cu_3P at a scanning rate of 0.2 mV s^{-1}.

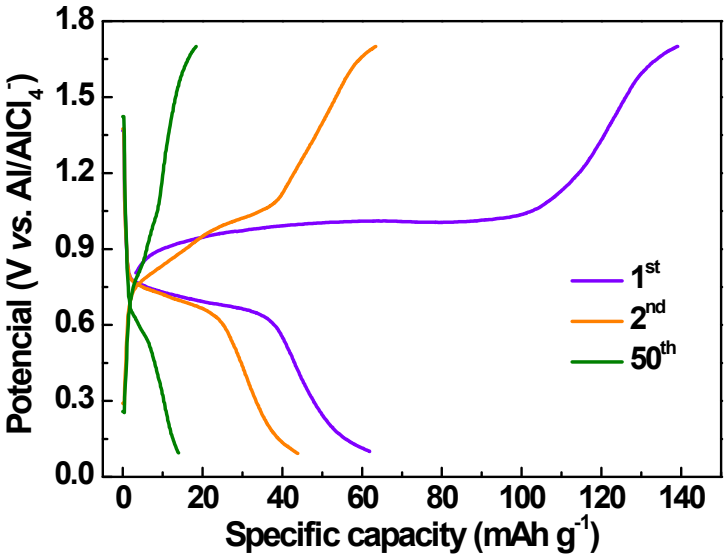

Fig. S8 Charge-discharge voltage profiles of Cu_3P for the 1st, 2nd, and 50th cycle at a current density of 50 mA g^{-1}.

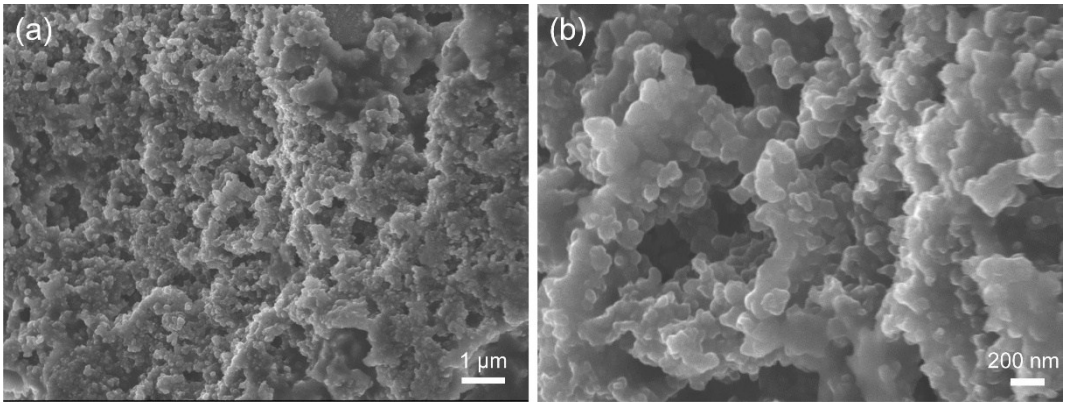

Fig. S9 SEM images of Cu_3P electrode after 50 cycles at 50 mA g^{-1}.

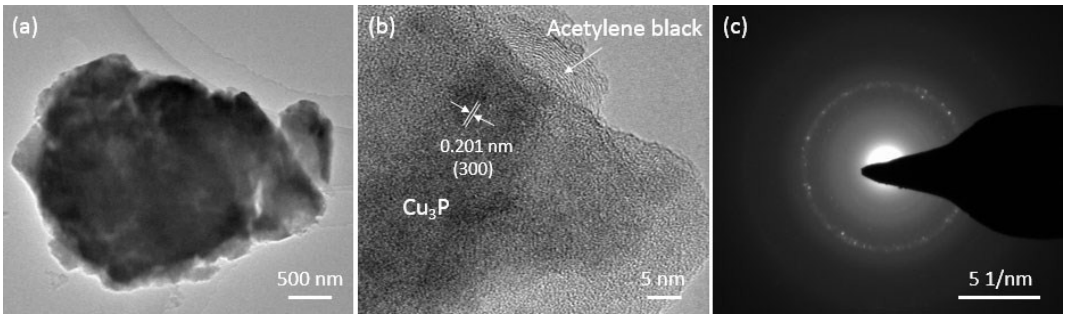

Fig. S10 (a) TEM and (b) HRTEM images and (c) SAED pattern of Cu_3P/C electrode after 50 cycles at 50 mA g^{-1}.

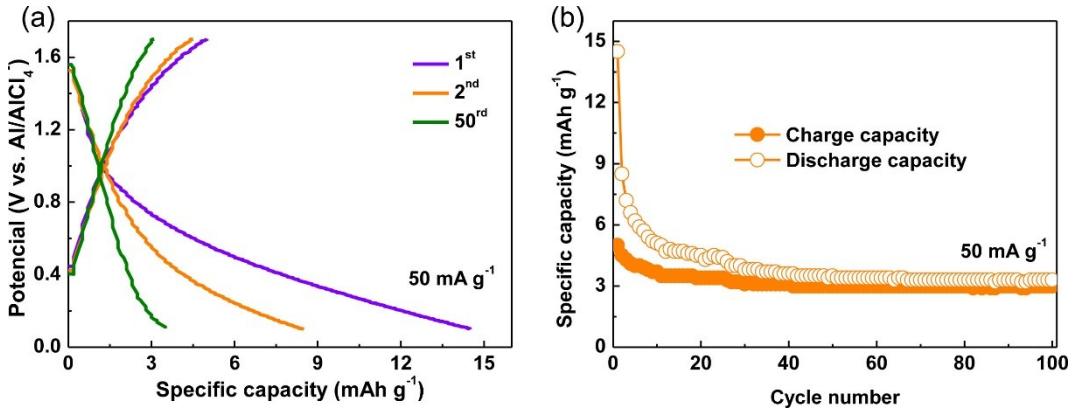

Fig. S11 (a) Charge-discharge voltage profiles of acetylene black for the 1st, 2nd, and 50th cycle. (b) Cycling performance of acetylene black. Current density: 50 mA g^{-1}.

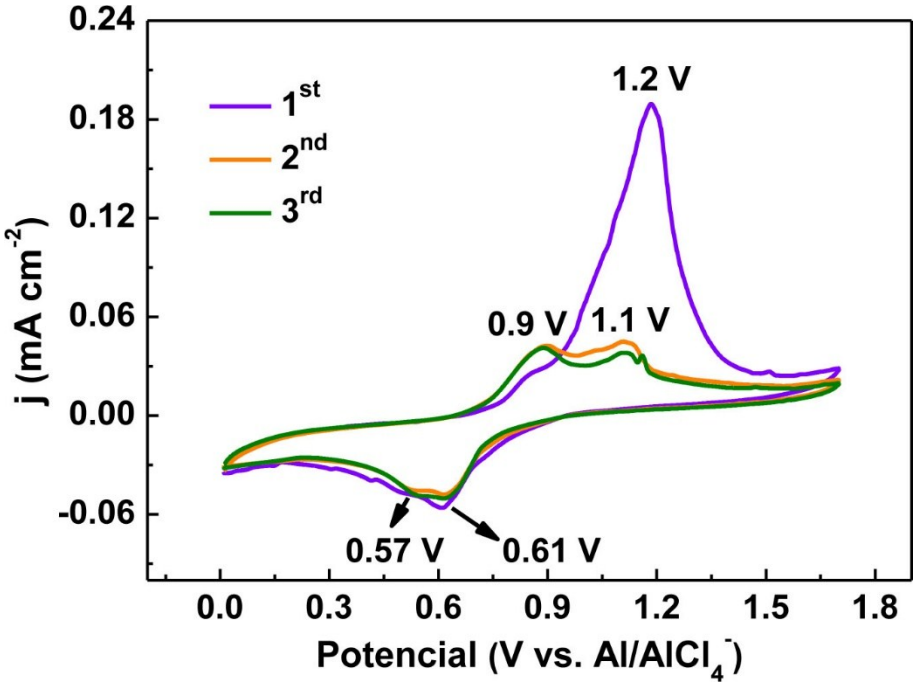

Fig. S12 CV curves of Cu_3P for the first three cycles at a scanning rate of 0.2 mV s^{-1}.

Table S1 Comparison of energy storage performance between Cu_3P/C and other transition metal-based cathode materials recently reported for rechargeable AIBs.

Cathode materials	**Electrolyte (molar ratio)**	**Current density (mA g^{-1})**	**Cycling performance**	**Ref.**
Cu_3P/C	**$AlCl_3$: [EMIm]Cl (1.3 : 1)**	**50**	**146.7 mAh g^{-1} (50^{th})**	**This work**
$Mo_{2.5+y}VO_{9+z}$	$AlCl_3$: [EMIm]Cl (1.1 : 1)	10	85 mAh g^{-1} (25^{th})	1
VO_2	$AlCl_3$: [EMIm]Cl (1 : 1 with 0.5 wt% $C_{14}H_{14}OS$)	50	116 mAh g^{-1} (100^{th})	2
Ni_3S_2@graphene	$AlCl_3$: [EMIm]Cl (1.3 : 1)	100	60 mAh g^{-1} (100^{th})	3
CuS@C	$AlCl_3$: [EMIm]Cl (1.3 : 1)	20	90 mAh g^{-1} (100^{th})	4
NiS	$AlCl_3$: [EMIm]Cl (1.3 : 1)	200	104.4 mAh g^{-1} (100^{th})	5
TiS_2	$AlCl_3$: [EMIm]Cl (1.5 : 1)	5	65 mAh g^{-1} (20^{th})	6
Mo_6S_8	$AlCl_3$: [EMIm]Cl (1.5 : 1)	12	70 mAh g^{-1} (50^{th})	7
G-SnS_2	$AlCl_3$: [EMIm]Cl (1.3 : 1)	200	70 mAh g^{-1} (100^{th})	8
WO_{3-x}	$AlCl_3$: [EMIm]Cl (1.3 : 1)	100	64.7 mAh g^{-1} (100^{th})	9
VS_4/rGO	$AlCl_3$: [EMIm]Cl (1.3 : 1)	100	80 mAh g^{-1} at 100^{th}	10
CuO	$AlCl_3$: [EMIm]Cl (1.3 : 1)	50	130.3 mAh g^{-1} (100^{th})	11
$NiCo_2S_4$	$AlCl_3$: [EMIm]Cl (1.3 : 1)	100	143.8 mAh g^{-1} (100^{th})	[12]
$Ni_{11}(HPO_3)_8(OH)_6$/rGO	$AlCl_3$: [EMIm]Cl (1.3 : 1)	200	41.9 mAh g^{-1} (1500^{th})	[13]

Reference

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