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

Supporting Information:

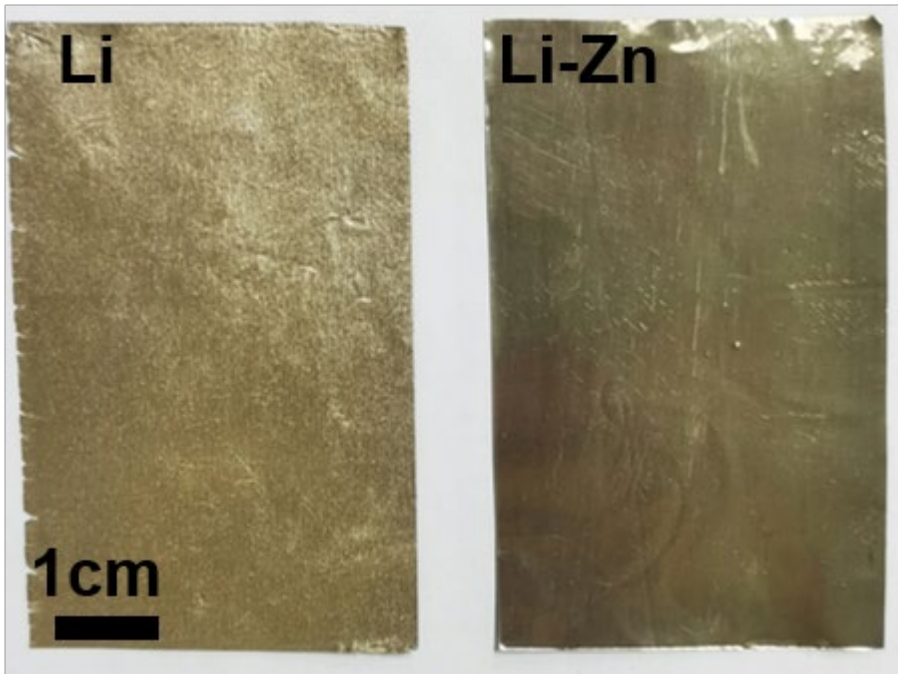

Figure S1. Digital images of Li and Li-Zn composite

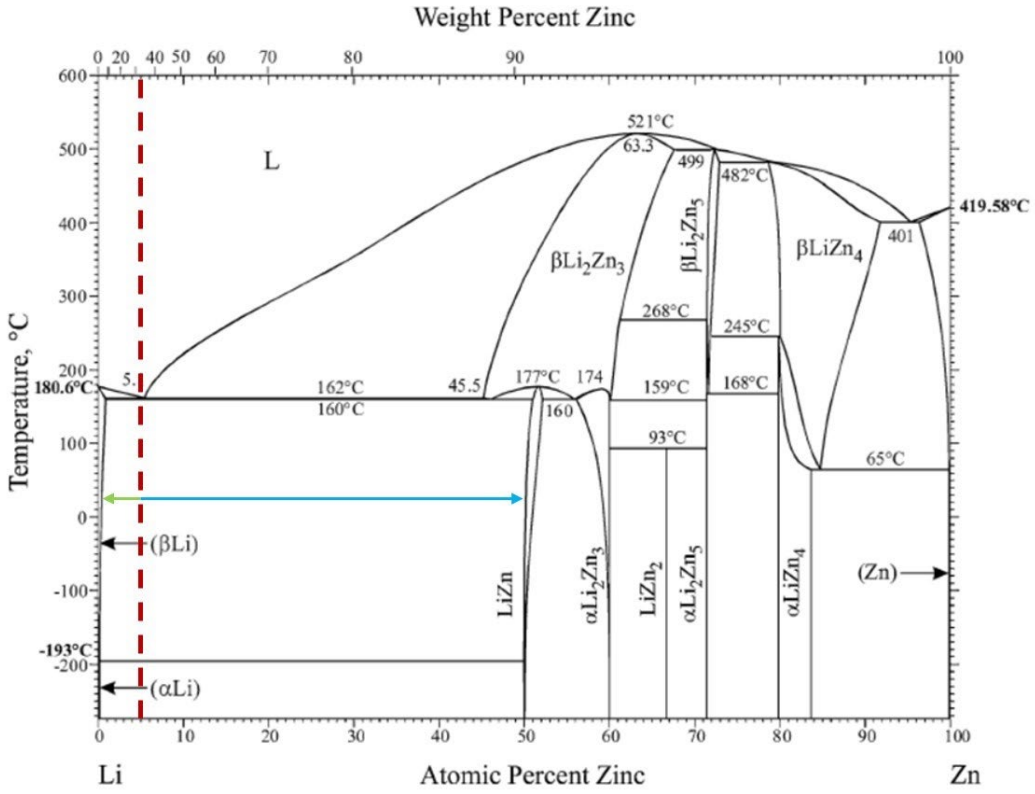

Figure S2. Phase diagram of Li-Zn composite

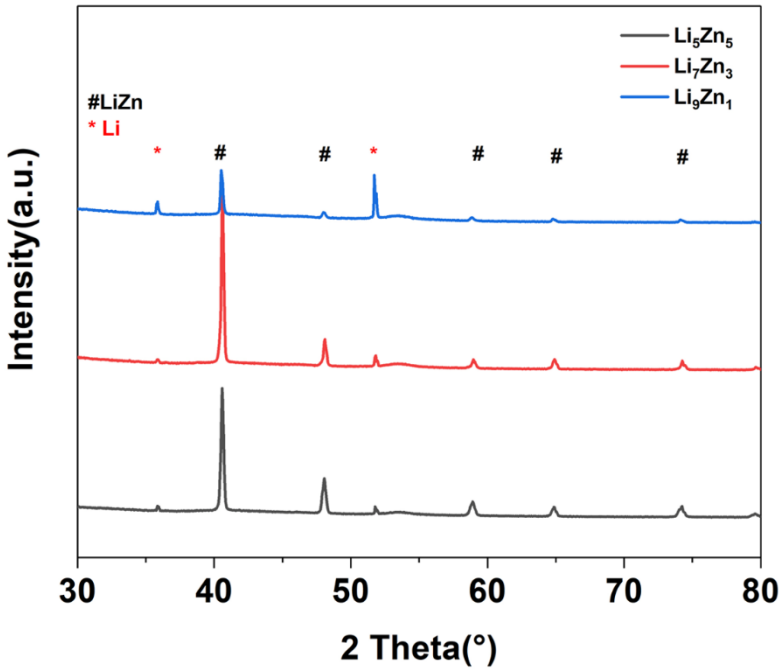

Figure S3. XRD of Li-Zn composites with different Zn dosage.

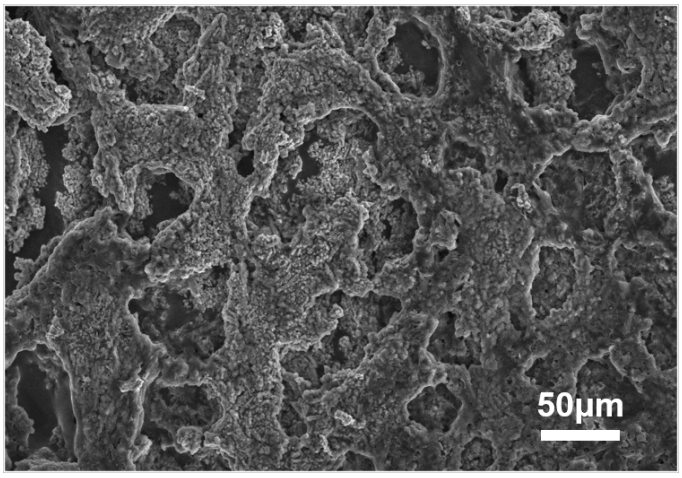

Figure S4. The SEM images of 3D skeleton of 50μm-thick Li-Zn foil after extracting 85% of Li inventory (8 mAh cm^{-2}).

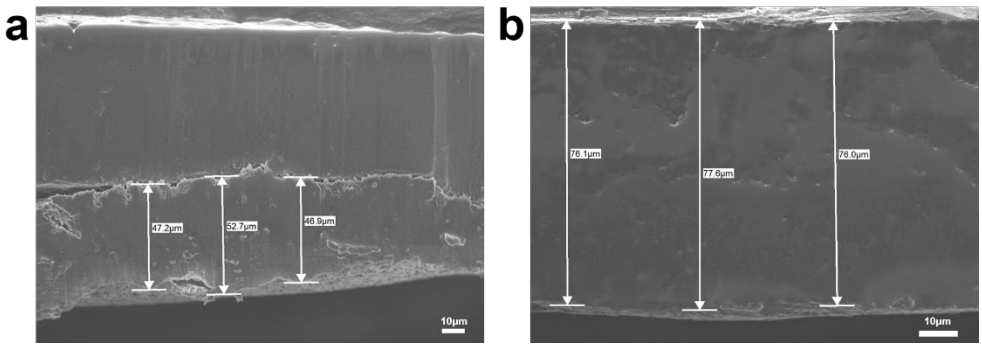

Figure S5. SEM images of the deposition layer of bare-Li (a) and LiZn (b) under 4 mAh cm^{-2}, respectively.

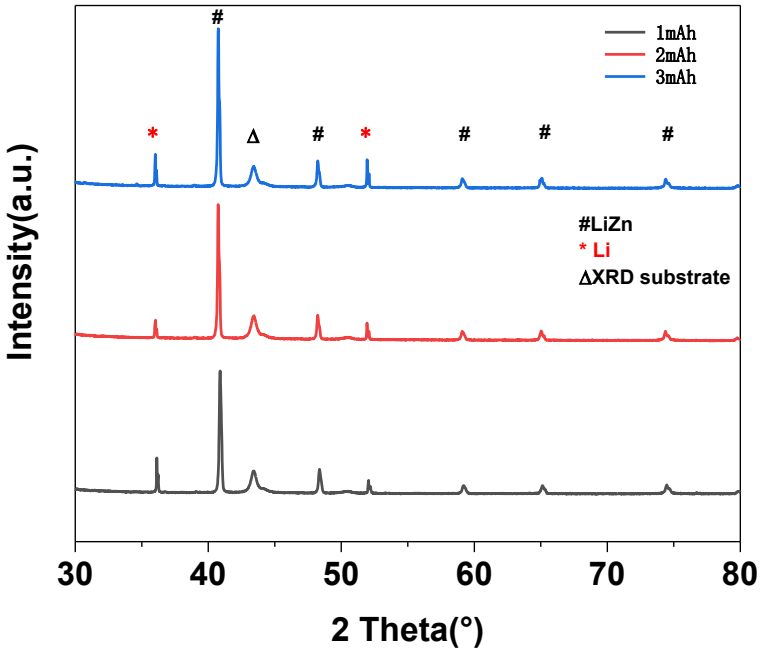

Figure S6. XRD of the Li-Zn anode with 1-3 mAh cm^{-2} plating.

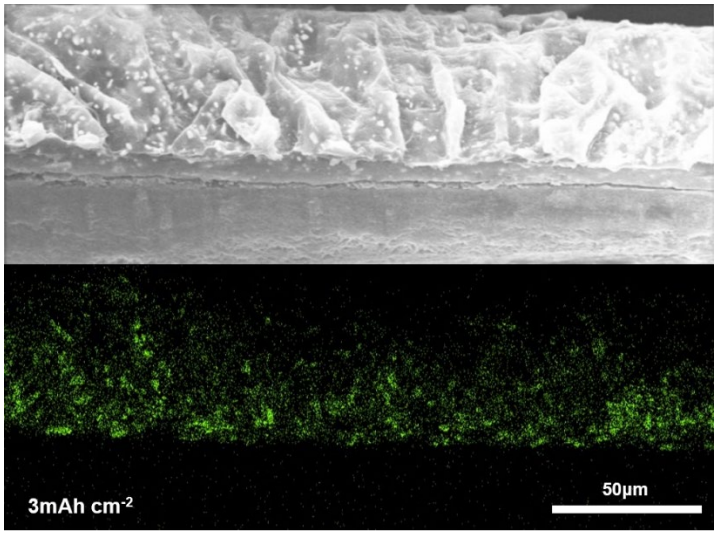

Figure S7. Cross-sectional SEM and EDS images of Li-Zn composite with 3 mAh cm^{-2} plating.

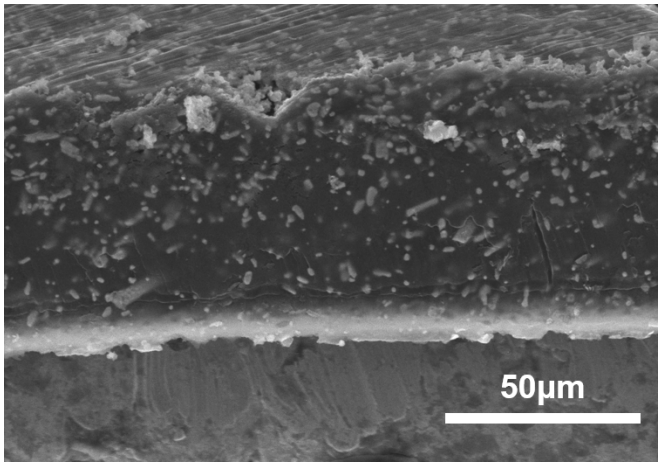

Figure S8. The cross-section SEM image of Li-Zn foil after 100 plating/stripping tests under the condition of 5 mA cm^{-2} and 2 mAh cm^{-2} (ended at stripping state).

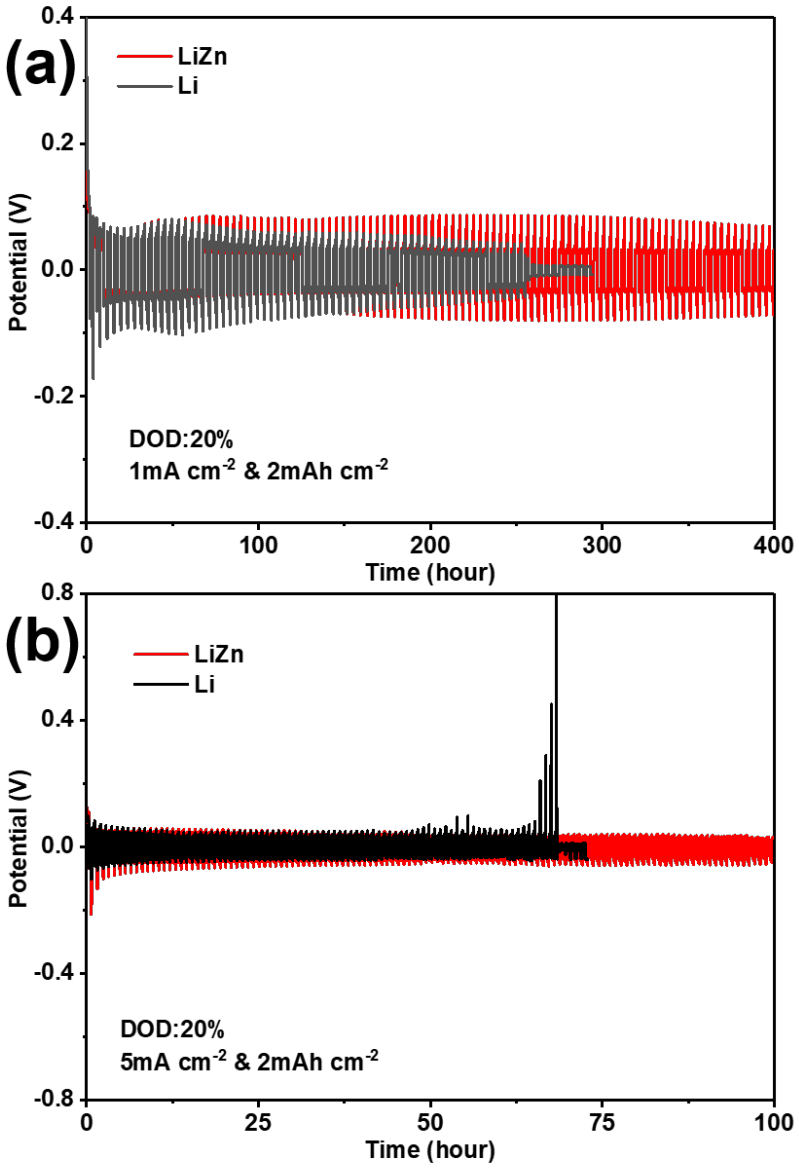

Figure S9. Stripping/plating test of bare-Li and Li-Zn composite symmetric cells (a) with an area capacity of 1 mAh cm^{-2} at 2 mA cm^{-2} with the electrolyte of 1M LiTFSI in DOL/DME (1:1 by volume) with 1 ωt% $LiNO_3$, and (b) with an area capacity of 2 mAh cm^{-2} at 5 mA cm^{-2} with the electrolyte of 2M LiFSI in DME. The depth of discharge (DOD) is 20%.

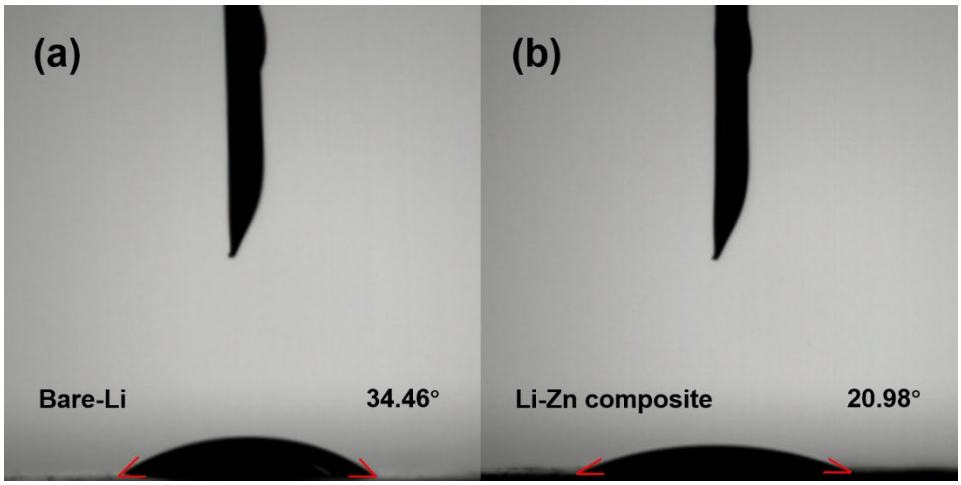

Figure S10. Contact angle measurements of the electrolyte (1M $LiFP_6$ in EC/DEC=v/v =1:1 with 10wt% FEC and 1wt% VC as additives) on the (a) bare-Li and (b) Li-Zn composite.

Table S1. Calculation of Zn dosage of Li-Zn composite

Mass ratio (Zn)	Mass ratio (Li)	Ar(Zn)/ g mol^{-1}	Ar(Li) / g mol^{-1}	Mass ratio (Zn) / Ar (Zn) / [Mass ratio (Zn) / Ar (Zn) + Mass ratio (Li) / Ar (Li)]
0.3	0.7	65.38	6.94	4.35%

Table S2. Calculation of volumetric capacity of Li-Zn composite

Discharge quantity/mAh	Diameter/mm	Thickness/μm	Volumetric capacity/mAh cm^{-3}	Gravimetric capacity/mAh g^{-1}
12.541	12	59	1880.4	2544.0

Table S3. Coin cells with different N/P ratio

Recipe	N/P ratio	Reference	Positive capacity /mAh cm^{-2}	Cathode	Electrolyte/μL	Cycle life	Current/C-rate
Li-LPS	253.7	Ref.32	0.39	LCO	/	200	1
Li-LiF	189.8	Ref.35	0.25	LFP	60	100	2
Li-Ca	128.8	Ref.29	0.32	LCO	/	500	1
$Li_{10}Zn$	111.4	Ref.28	0.70	LTO	/	4000	1
$Li_{13}In_3$|Li	85.8	Ref.37	0.38	LTO	40	1500	5
Armored Li	71.4	Ref.36	1.44	NCM	80	150	0.5
Patterned Li	69.8	Ref.38	1.33	LMO	250	450	0.5
GaLi-Li	42.8	Ref.13	1.68	LFP	100	200	0.5
Li-0.3Zn	40.8	Ref.27	0.26	LFP	/	200	1
Mg-Li	38.7	Ref.26	0.80	LFP	30	100	3
LLN@Li	10.3	Ref.34	1.00	LFP	50	150	1
Li-Al	10.0	Ref.23	4.10	NCM	30	180	1
Li@PI-ZnO @Cu3N-SBR	3.3	Ref.33	3.00	LTO	50	100	0.5
Li-Zn	3.3	Our work	3.00	LFP	40	130	0.5
Li@SCS	1.2	Ref.11	2.70	LFP	80	45	0.5

Table S4. Calculation of the energy density of jelly roll

Discharge Energy/Wh	Electrode & Separator/g	Electrolyte/ g	Thickness of Electrode & Separator /μm	Volume/cm^{-3}	Volumetric Energy Density/Wh L^{-1}	Mass Energy Density /Wh kg^{-1}
2.782	5.1	2.7	910	2.275	1222.9	356.7