Supporting Information

Atomic layer deposited zinc oxysulfide anodes in Li-ion batteries: An efficient solution for electrochemical instability and low conductivity

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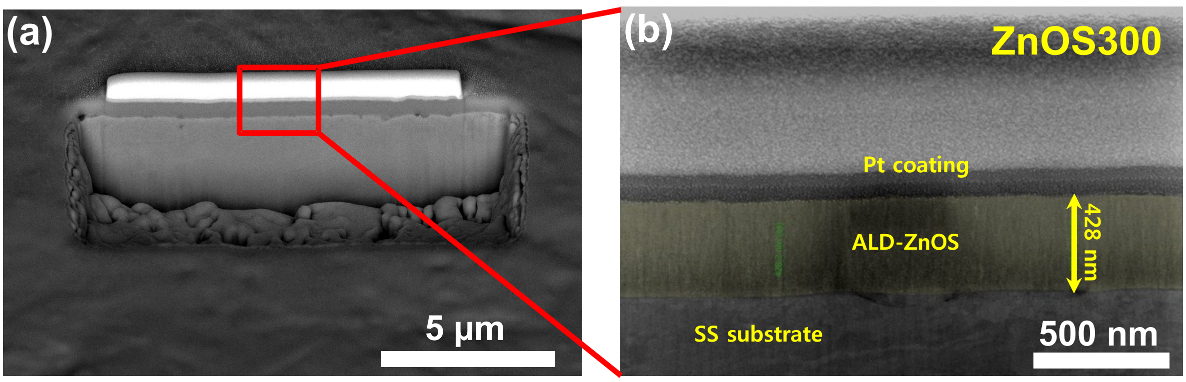

Fig. S1 (a-b) Cross-sectional SEM images of ZnOS300 on a SS substrate obtained by using FIB-SEM

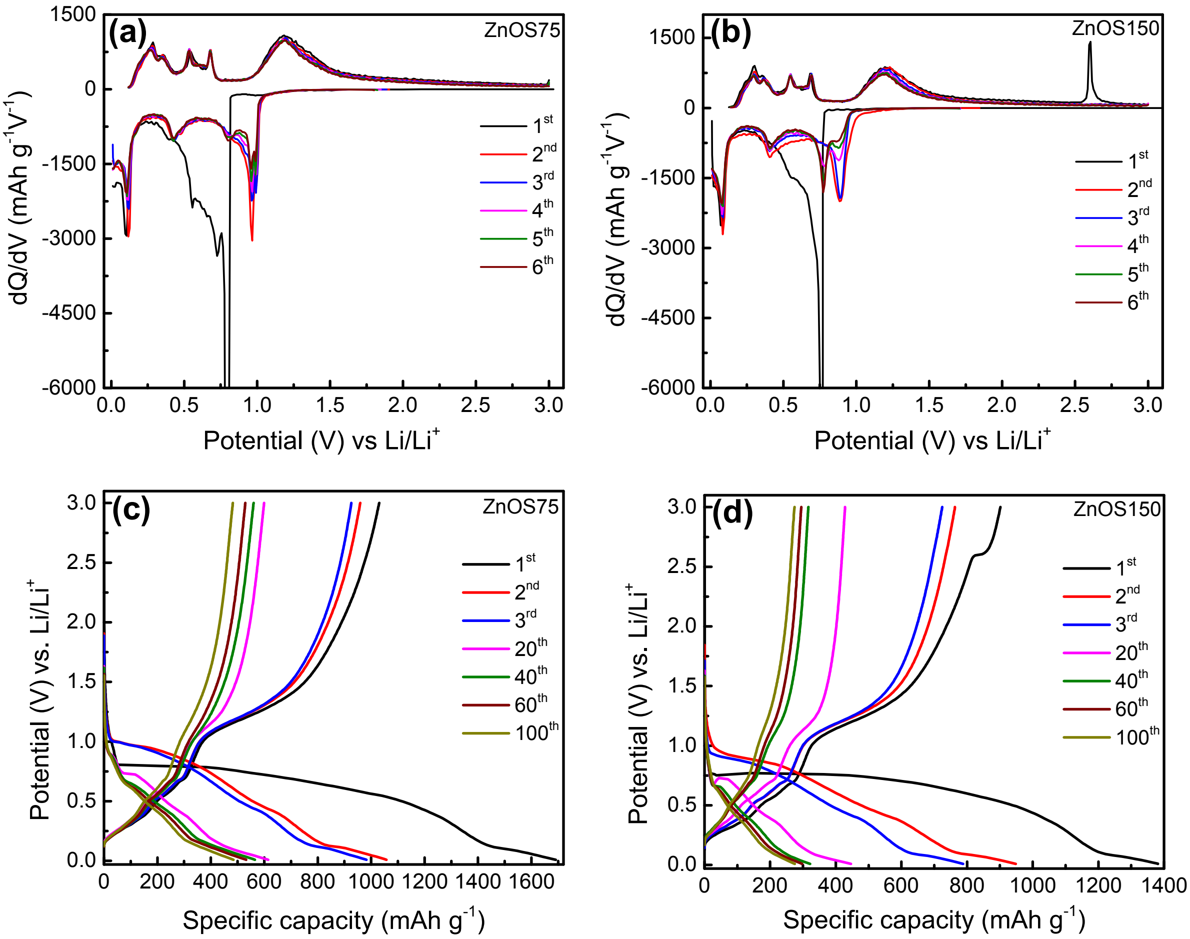

Fig. S2 dQ/dV plots for the first six consecutive cycles, as derived from the charge-discharge profiles of the (a, c) ZnOS75 and (b, d) ZnOS150 anodes in LIBs at 1 A g^{-1}.

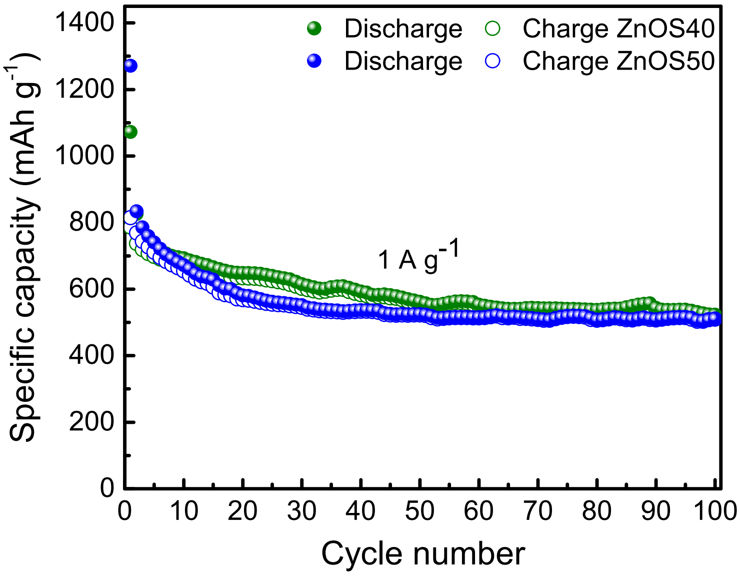

Fig. S3 Cycling performance comparison of the ZnOS40 and ZnOS50 electrodes in LIBs at 1 A g^{-1}.

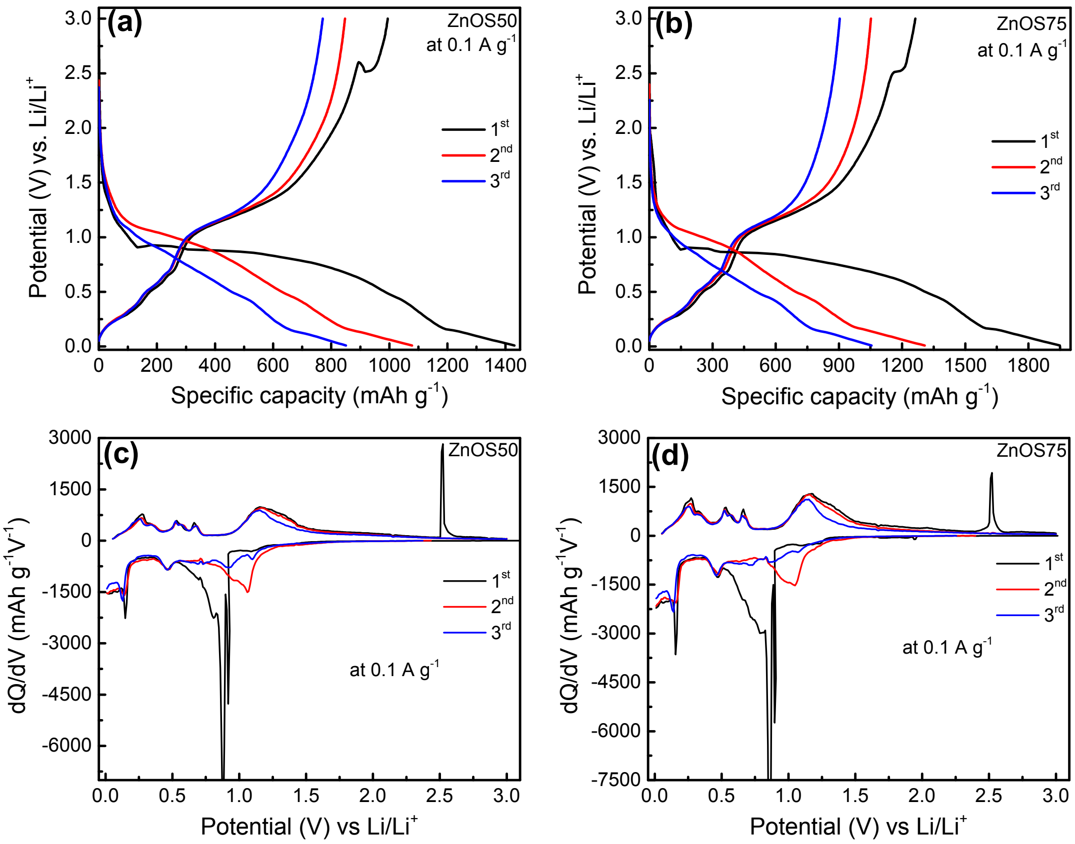

Fig. S4 Charge-discharge profiles at 0.1 A g^{-1} current density and the corresponding dQ/dV plots for the first three consecutive cycles of the (a, c) ZnOS50 and (b, d) ZnOS75 anodes in LIBs.

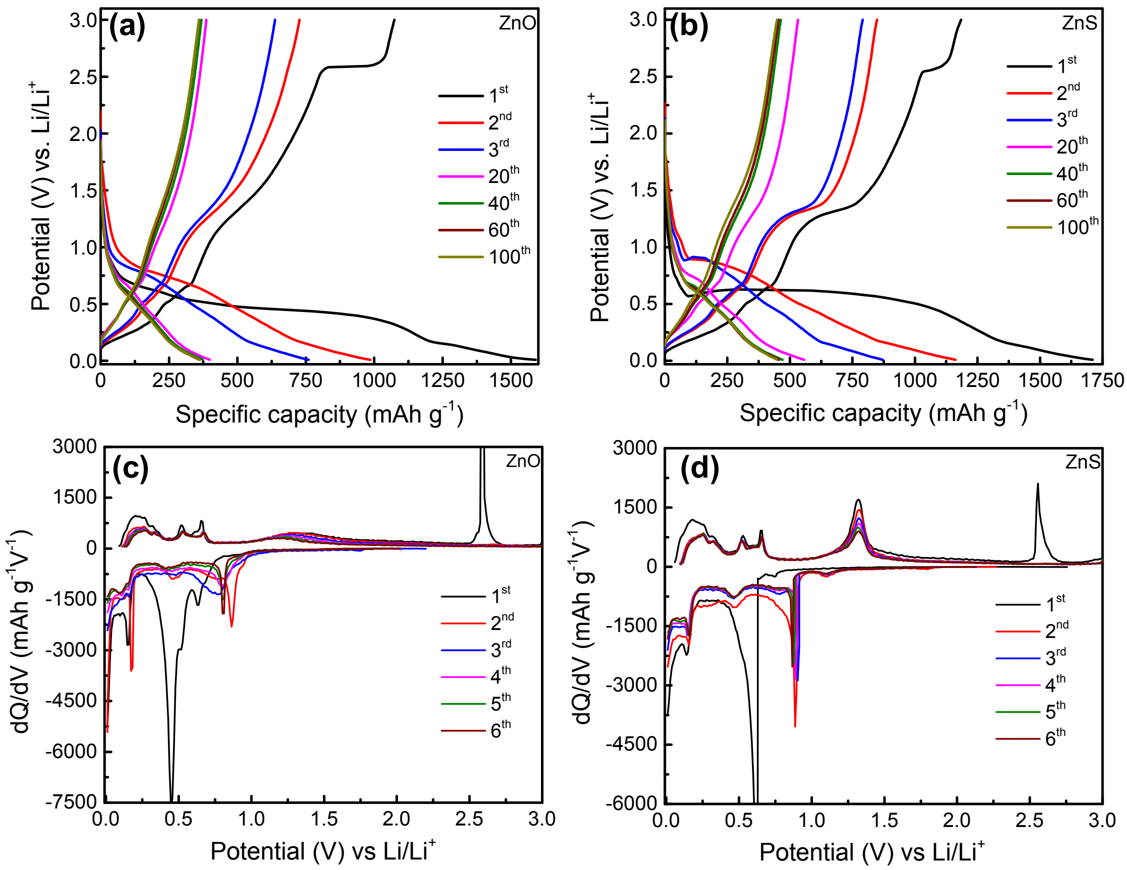

Fig. S5 Charge-discharge profiles for 100 cycles at 1 A g^{-1} current density and the corresponding dQ/dV plots for the first six consecutive cycles of the pristine (a, c) ZnO and (b, d) ZnS anodes in LIBs.

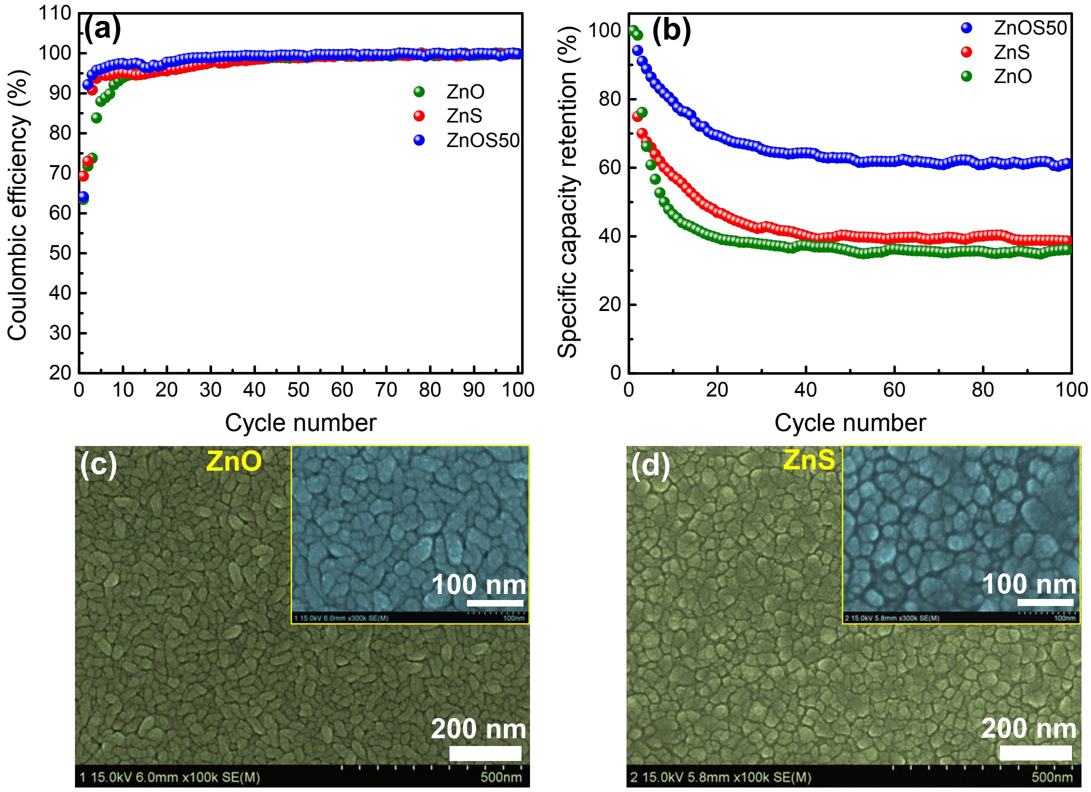

Fig. S6 (a) Coulombic efficiency and (b) specific capacity retention corresponding to 100 charge-discharge cycles for the ZnO, ZnS, and ZnOS50 anodes at 1 A g^{-1} current density. Plan-view FESEM images of (c) ZnO and (d) ZnS on SS substrate before the charge-discharge process. The insets represent high-magnification images.

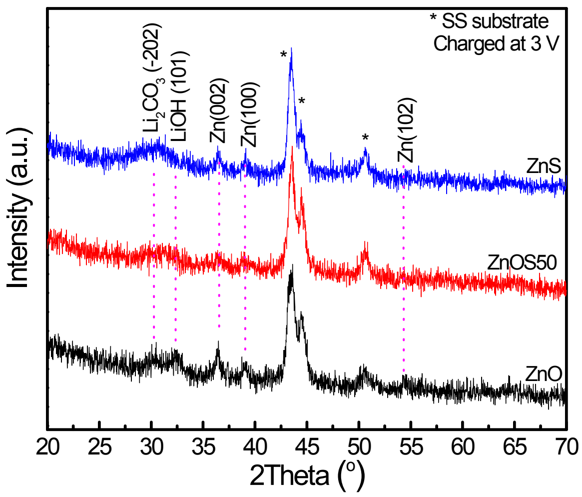

Fig. S7 *Ex situ* XRD patterns of pristine ZnO, ZnS, and ZnOS50 electrodes in LIBs after complete charge at 3.0 V.

Table S1. A comparison of the electrochemical performances of a few ZnO, ZnS, and ZnOS-based anode materials for LIBs, including the results of this study.

*Obtained from rate studies

	Anode materials	Material growth process	Electrochemical performance: Stable specific capacity (mAh g^{-1})	Electrochemical performance: Specific capacity at current density* (mAh g^{-1})	Ref
ZnO	ZnO thin film/SS	PLD	220, 40 cycles at 20 μA cm^{-2}	–	1
	yolk-shell ZnO-C microspheres	Chemical solution reaction	520, 150 cycles at 100 mA g^{-1}	212 at 1 A g^{-1}	2
	Graphite-coated ZnO nanosheets/Pt/SS	Hydrothermal	600, 100 cycles at 1 A g^{-1}	–	3
	ZnO-C-rGO nanofiber	Co-axial electrospinning	618.9, 100 cycles at 50 mA g^{-1}	472 at 500 mA g^{-1}	4
	ZnO@ZnO QDs/C core–shell NRAs/CC	Chemical route	699, 100 cycles at 500 mA g^{-1}	530 at 1 A g^{-1}	5
	Al_2O_3/ZnO-Gr/Cu foil	ALD	487, 100 cycles at 100 mA g^{-1}	415 at 1 A g^{-1}	6
	ZnO QD/graphene/Cu foil	ALD	540, 100 cycles at 100 mA g^{-1}	400 at 1 A g^{-1}	7
	ZnO–CB	ALD	1026, 500 cycles at 100 mA g^{-1}	1213 at 1 A g^{-1}	8
	ZnO/expanded graphite composite	ALD	436.4, 500 cycles at 200 mA g^{-1}	417 at 800 mA g^{-1}	9
	3D-C/ZnO NMs foam composite	ALD	260,700 cycles at 2 A g^{-1} and 180, 500 cycles at 5 A g^{-1}	288 at 1 A g^{-1}	10
ZnS	ZnS/graphene composites/Cu foil	Solvothermal	570, 200 cycles at 200 mA g^{-1}	418 at 1 A g^{-1}	11
	ZnS/porous carbon matrix/Cu foil	Chemical route	438, 300 cycles at 100 mA g^{-1}	180 at 1 A g^{-1}	12
	ZnS nanocrystal/RGO composite/ Cu sheet	Hydrothermal	776, 100 cycles at 100 mA g^{-1}	–	13
	Core-shell-ZnS/C nanocomposite/Cu foil	Solvothermal	750, 300 cycles at 500 mA g^{-1}	–	14
	ZnS decorated on N-doped porous carbon polyhedra/Cu foil	Co-precipitation	856.8, 1000 cycles at 1 A g^{-1}	–	15
	ZnS/C/ Cu foil	Ball milling	570, 150 cycles at 100 mA g^{-1}	–	16
ZnOS	ZnO/SS	PLD	285,40 cycles at 2 μA cm^{-2}	–	17
	ZnS/SS		312,40 cycles at 2 μA cm^{-2}		
	O-rich ZnOS/SS		373,40 cycles at 2 μA cm^{-2}		
	S-rich ZnOS/SS		600,40 cycles at 2 μA cm^{-2}		

ZnO/SS	**ALD**	**360, 100 cycles at 1 A g^{-1} (~ 40 μA cm^{-2})**	**–**	**This work**
ZnS/SS		**449.2, 100 cycles at 1 A g^{-1} (~ 40 μA cm^{-2})**		
O-rich ZnOS/SS		**510.3, 100 cycles at 1 A g^{-1} (~ 40 μA cm^{-2})**		

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