Supporting Information

Preparation and Controllable Prelithiation of Core-Shell C@SnO_x Composites for High-Performance Lithium-Ion Battery

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The Supporting information includes **10 Figures and 3 Tables**

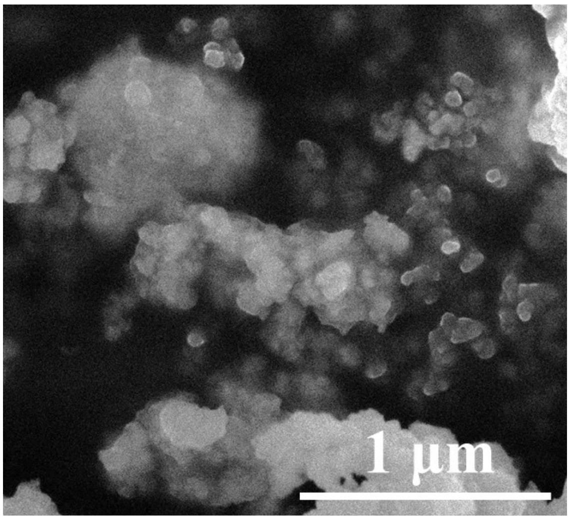

Figure S1. SEM images of SnO_x@C nanoparticles with heat treatment temperature of 400°C

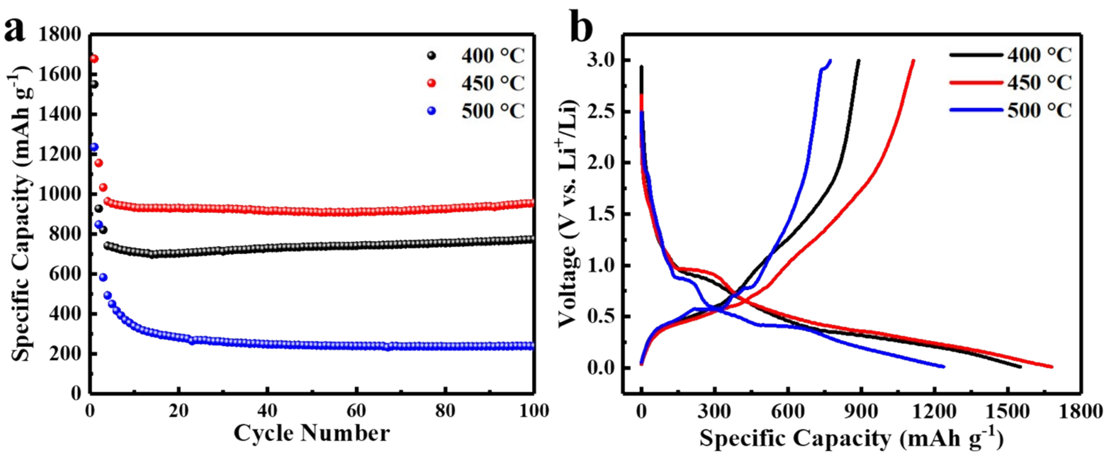

Figure S2. (a) Cycling performance of SnO_x@C with different synthesis temperature at 0.5 A g^{-1}; (b) First charge and discharge curves of SnO_x@C with different synthesis temperature at 0.5 A g^{-1}

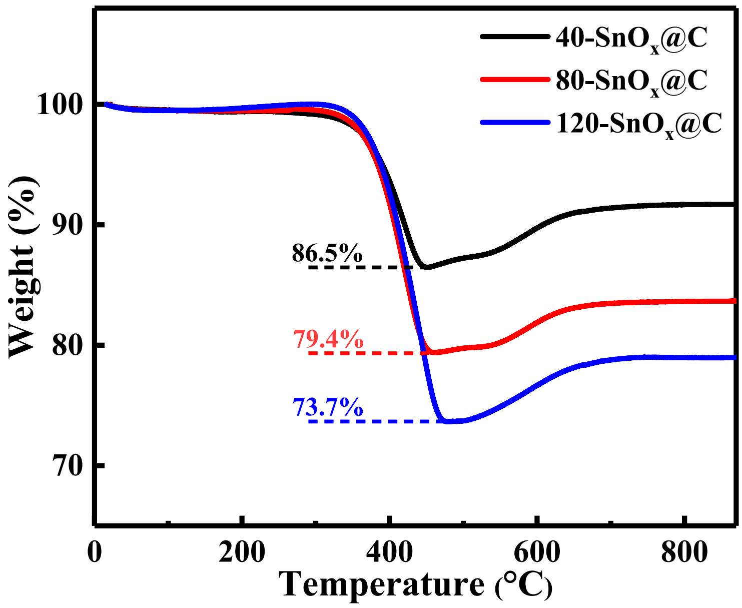

Figure S3. TG curves in air of SnO_x@C with different coating thickness

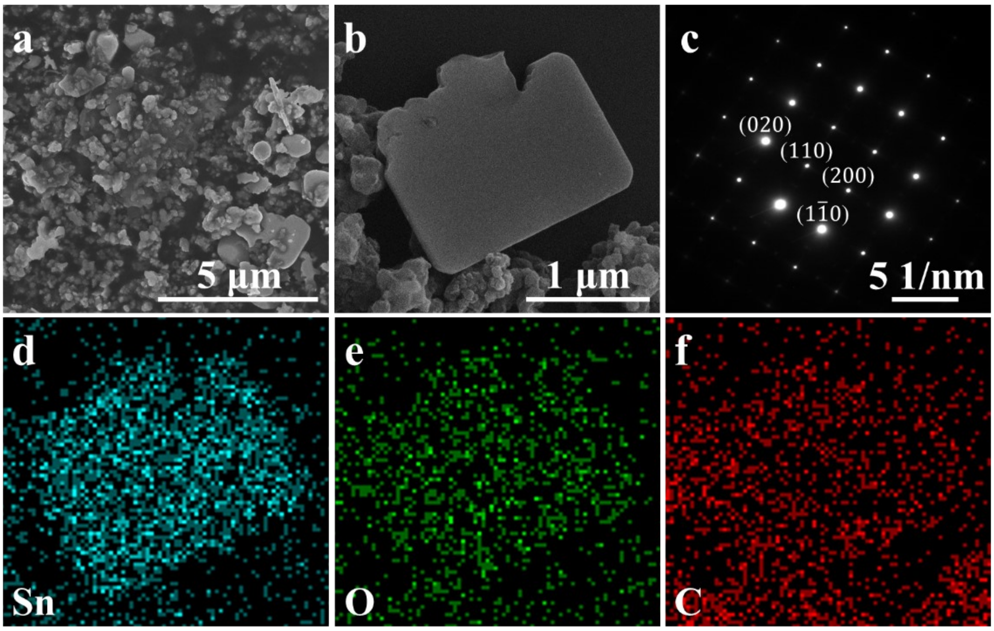

Figure S4. (a, b) SEM images of SnO_x@C; (c) SAED patterns of nanosheets of SnO_x@C; (d-f) Element mapping images of the nanosheets corresponding to SEM image shown in (b)

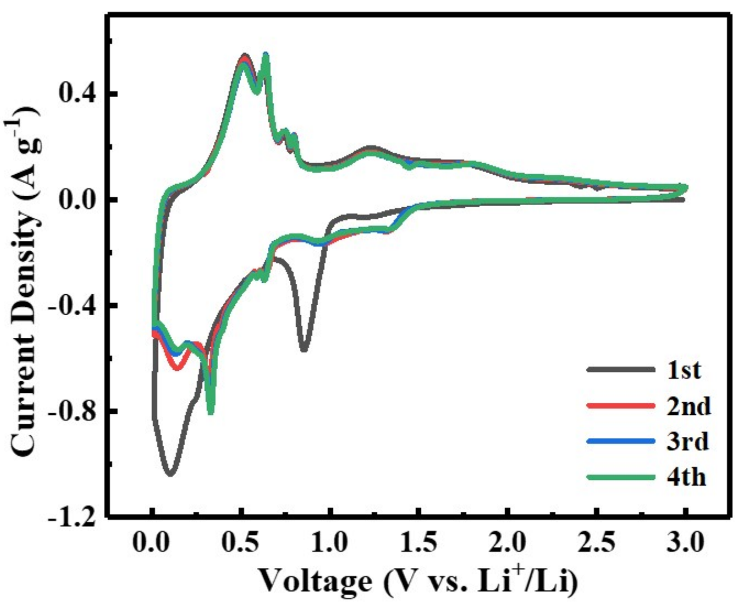

Figure S5. CV profiles of 80-SnO_x@C anode at 0.1 mV s^{-1}

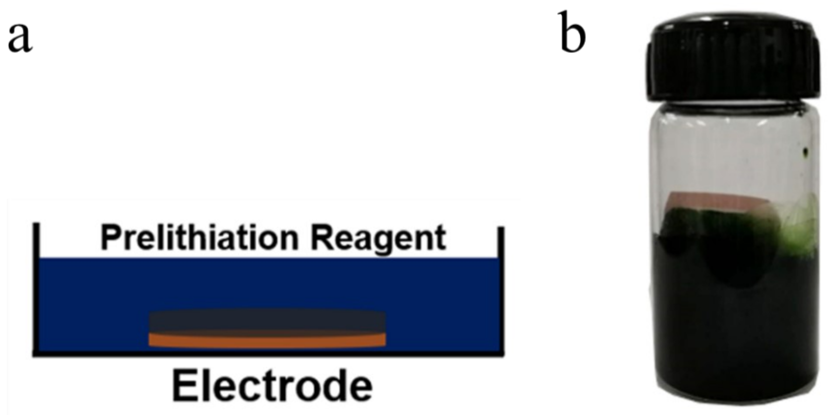

Figure S6. (a) Experimental device diagram of chemical prelithiation; (b) Photo of Lithium-4,4'-Dimethylbiphenyl reagent (1 M Li-4,4’-DMBP)

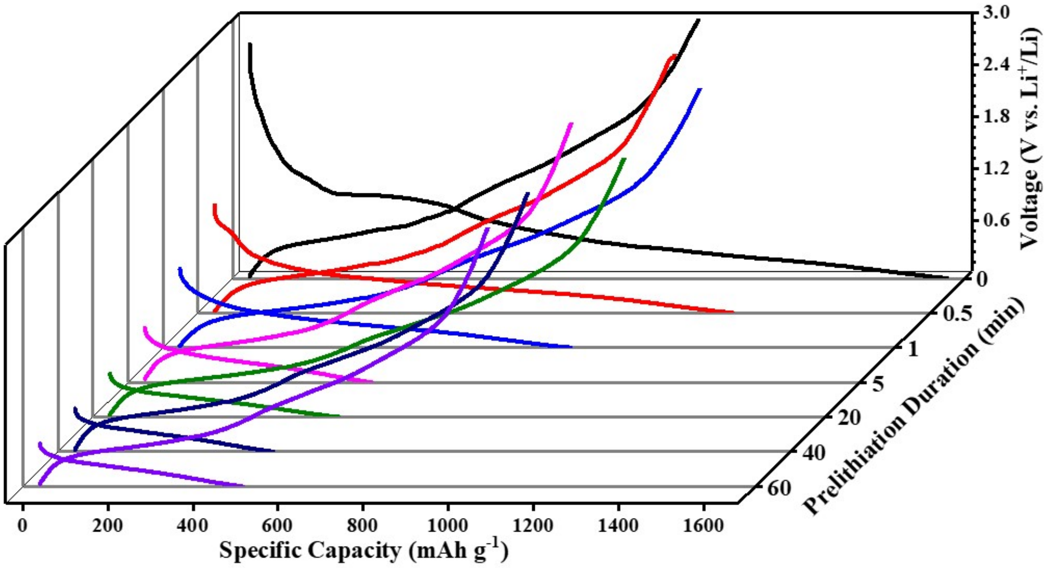

Figure S7. The first discharge/charge curves of the Li-SnO_x@C||Li half cells with different immersion time at 0.1 C rate

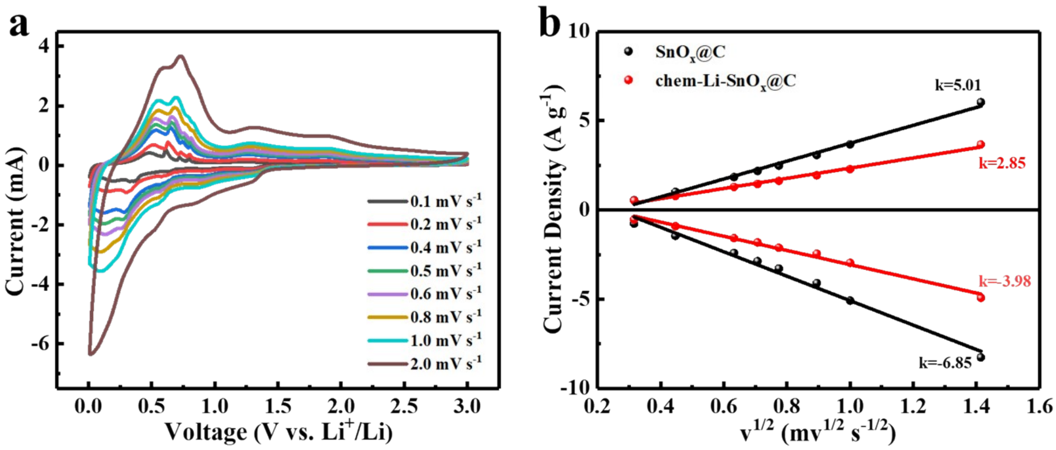

Figure S8. (a) Cyclic voltammetry curves of Li-SnO_x@C at different scanning rates; (b) Fitting lines between peak current and square root of scanning rates of SnO_x@C and Li-SnO_x@C

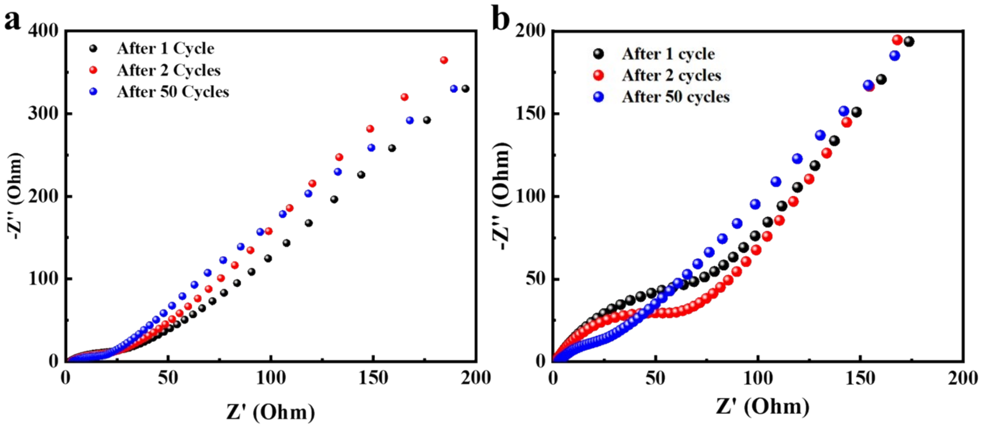

Figure S9. EIS at different cycles (a) 80-SnO_x@C; (b) Li-SnO_x@C

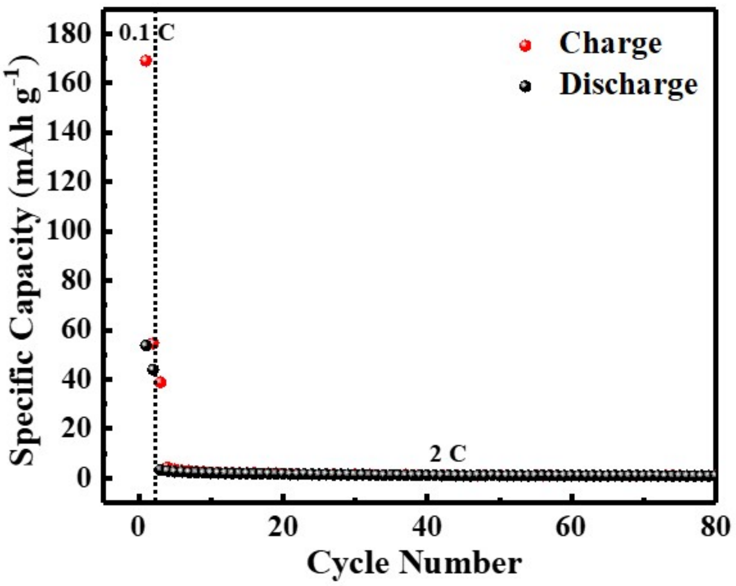

Figure S10. Cycling performance of the LFP||SnO_x@C full-cell without prelithiation at 2 C

Table S1 The relationship between carbon layer thickness and the addition amount of resorcinol and formaldehyde

Anode with different carbon layer thickness	Thickness (nm)	Resorcinol (mg)	Formaldehyde (μL)
40-SnO_x@C	10	40	56
80-SnO_x@C	13	80	112
120-SnO_x@C	25	120	168

Table S2 Comparison between this work with other references (SnO_x@C with different structure)

	Morphology	Cutoff Voltage (V)	Electrolyte	ICE (%)	Reversible Capacity (mAh g^{-1} at 1A g^{-1})	Cycle Performance	References
1	Core-shell nanospheres	0.01-3.0	1 M $LiPF_6$ in EC:DEC (1:1 *v*/*v*) with 5.0 vol % FEC	**64.3 (1 A g^{-1})**	**854.2**	**804.1 mAh g^{-1}** at **1 A g^{-1}** after 300 cycles	This work
2	Rod-like hierarchical nanostructures	0.01-3.0	1 M $LiPF_6$ in EC:DMC:DEC (1:1:1 *v*/*v*/*v*)	71.1 (0.2 A g^{-1})	823	1001mAh g^{-1} at 0.2 A g^{-1} after 240 cycles	[1]
3	Walnut core-like hollow carbon micro/nanospheres	0.01-3.0	1 M $LiPF_6$ in EC:DMC (1:1 *v*/*v*)	49 (0.2 A g^{-1})	359	853mAh g^{-1} at 0.2 A g^{-1} after 400 cycles	[2]
4	Carbon matrix encapsulating heterostructured SnO_x ultrafine nanoparticles	0.01-3.0	1 M $LiPF_6$ in EC:DMC (1:1 *v*/*v*)	61.4 (0.1 A g^{-1})	745.6	447.8 mAh g^{-1} at 5 A g^{-1} after 1200 cycles	[3]
5	Sn and SnO_x dispersed in carbon nanofibers	0.01-3.0	1 M $LiPF_6$ in EC:DEC (1:1 *v*/*v*)	77 (0.5 A g^{-1})	442	300 mAh g^{-1} at 0.5 A g^{-1} after 500 cycles	[4]

Table S3 The open circuit voltage, initial coulombic efficiency and prelithiation degree of half cells in different immersion time

Immersion Time (min)	OCV (V)	ICE (%)	Prelithiation Degree (%)
0	**2.71**	**64.34**	**-**
0.5	1.2534	88.87	30.57
1	0.9170	133.22	53.96
5	0.6364	188.15	67.43
20	**0.5109**	**224.86**	**72.68**
40	0.5093	228.34	73.00
60	0.5016	221.27	72.20

Prelithiation degree can be calculated by the following equation:

$$\text{ICE after prelithiation} = \frac{\text{First charge capacity without prelithiation}}{\text{First disharge capacity without prelithiation} \times \left(1 - \text{prelithiation degree}\right)}$$

References

1. J. Yang, S. Chen, J. Tang, H. Tian, T. Bai and X. Zhou, *ApSS*, 2018, **435**, 203-209.
2. Q. Tian, Y. Chen, F. Chen, J. Chen and L. Yang, *J. Colloid Interface Sci.*, 2019, **554**, 424-432.
3. H. Li, B. Zhang, X. Ou, L. Tang, C. Wang, L. Cao, C. Peng and J. Zhang, *Ceram. Int.*, 2019, **45**, 18743-18750.
4. D. Spada, P. Bruni, S. Ferrari, B. Albini, P. Galinetto, V. Berbenni, A. Girella, C. Milanese and M. Bini, *Mater. (Basel)*, 2022, **15**.