Supplementary Information

Sn_4P_3-C nanospheres as high capacitive and ultra-stable anodes for sodium ion and lithium ion batteries

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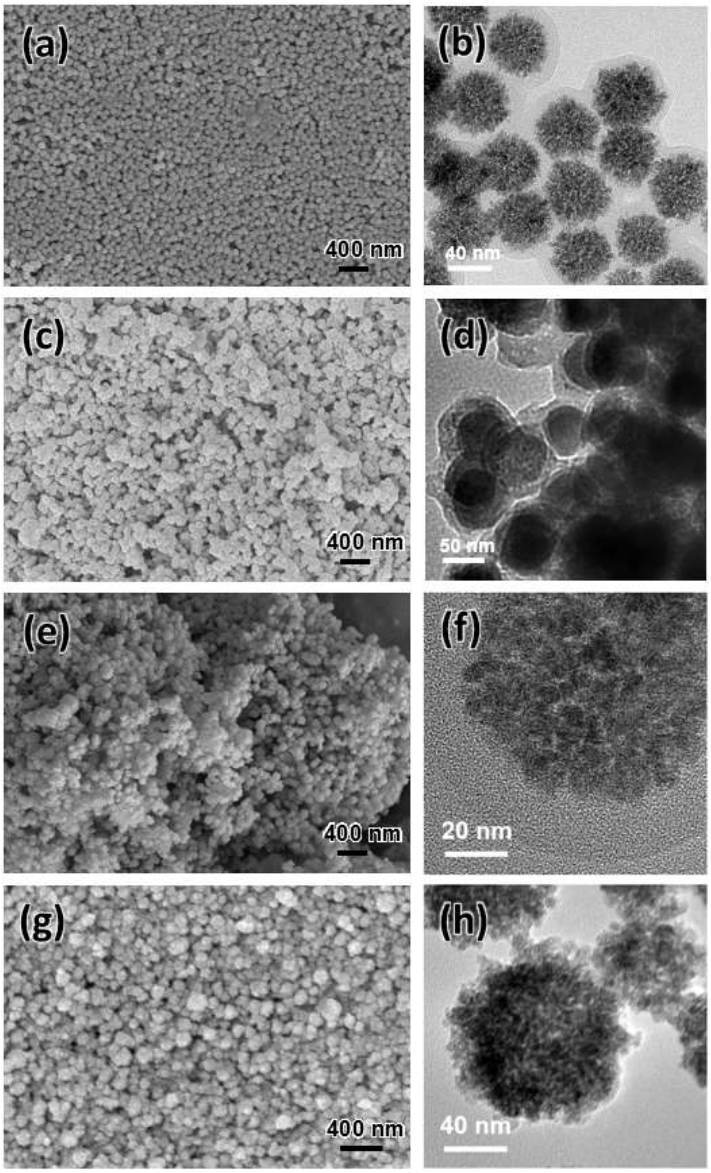
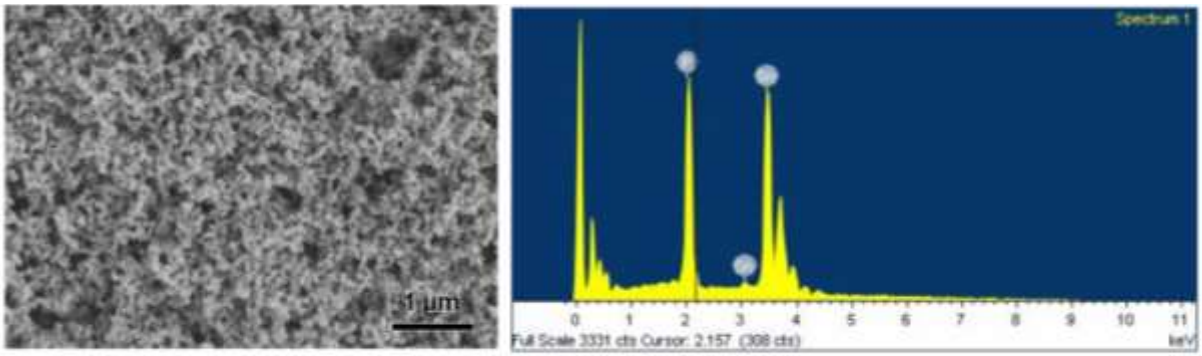


Fig. S1 SEM and TEM images of nanospheres: (a),(b) SnO_2-GCP, (c),(d) Sn-C, (e),(f) Sn_4P_3-C, and (g),(h) Sn_4P_3 nanospheres.



Element	Weight %	Atomic %
Sn	84.28	58.32
P	15.72	41.68

Fig. S2 EDS results for the Sn_4P_3-C nanospheres.

BET Sample	Surface area (m^2/g)
Sn_4P_3-C nanosphere	65.4
Sn-C nanosphere	17.5

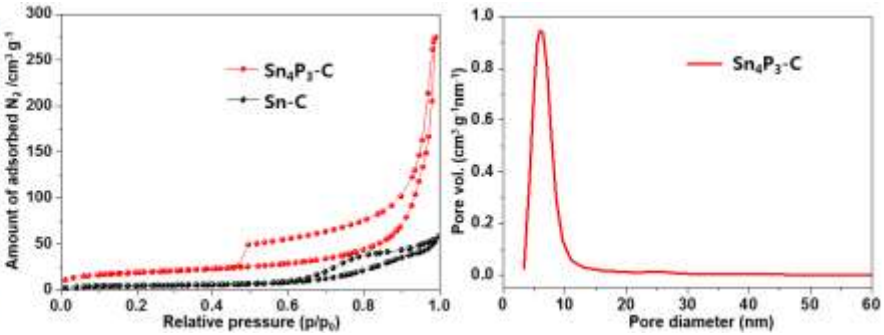


Fig. S3 BET results for the Sn-C and Sn_4P_3-C nanospheres.

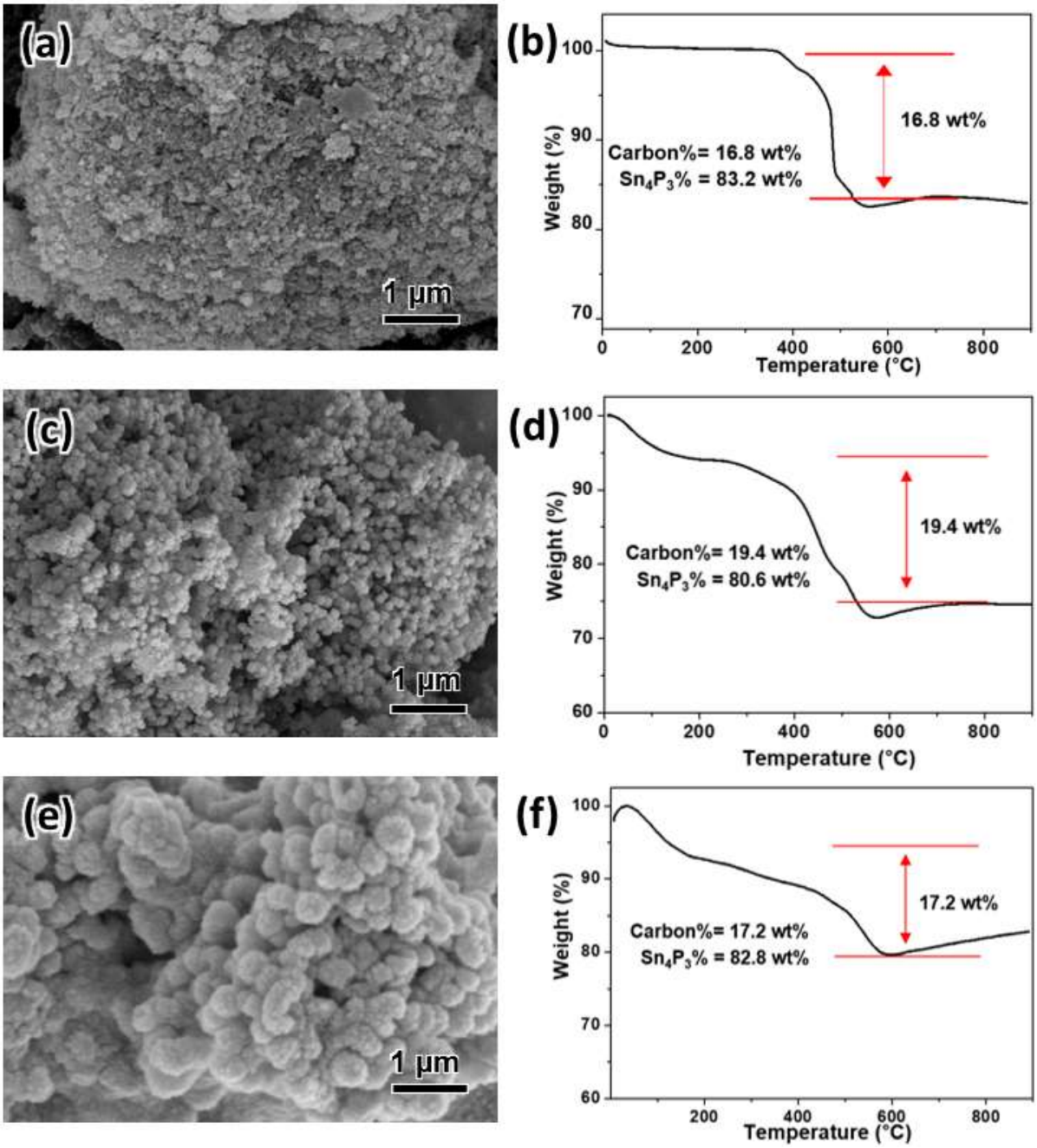


Fig. S4. Low magnification SEM images and TGA curves for Sn_4P_3-C nanospheres. (a),(b): 30 nm, (c),(d): 140 nm, and (e),(f): 300 nm.

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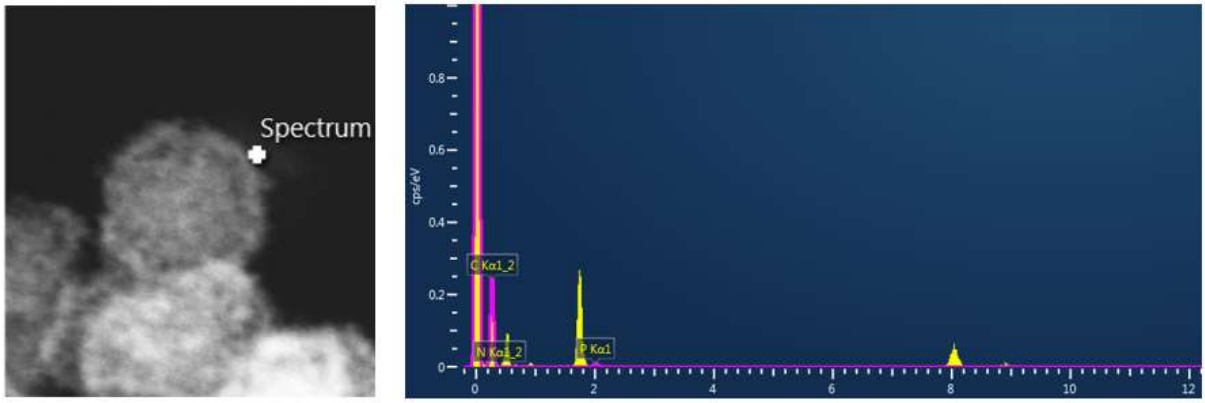

Element	Line type	K Factor	Absorption Correction	Wt%	Wt% Sigma
C	K series	2.784	1.00	**97.93**	2.68
N	K series	3.534	1.00	**0.00**	2.71
P	K series	1.057	1.00	**2.07**	0.42

Fig. S5. EDS analysis of carbon shell in Sn_4P_3-C nanospheres.

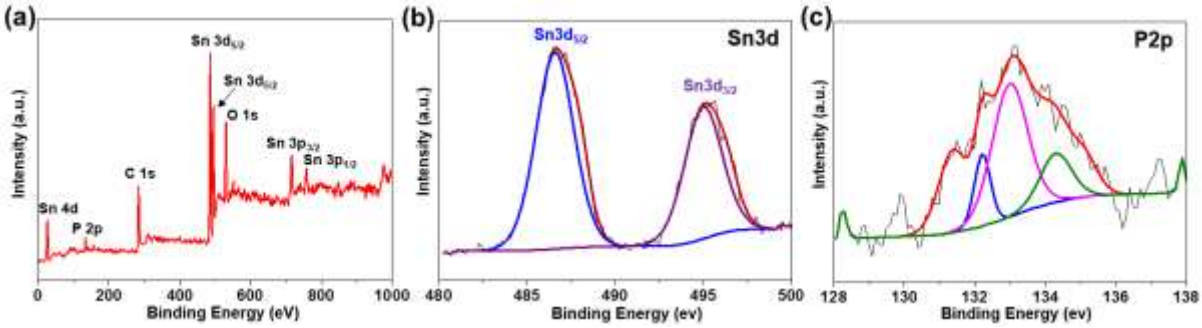

Fig. S6. (A) Survey, (B) Sn3d, and (C) P2p XPS spectra for Sn_4P_3-C nanospheres.

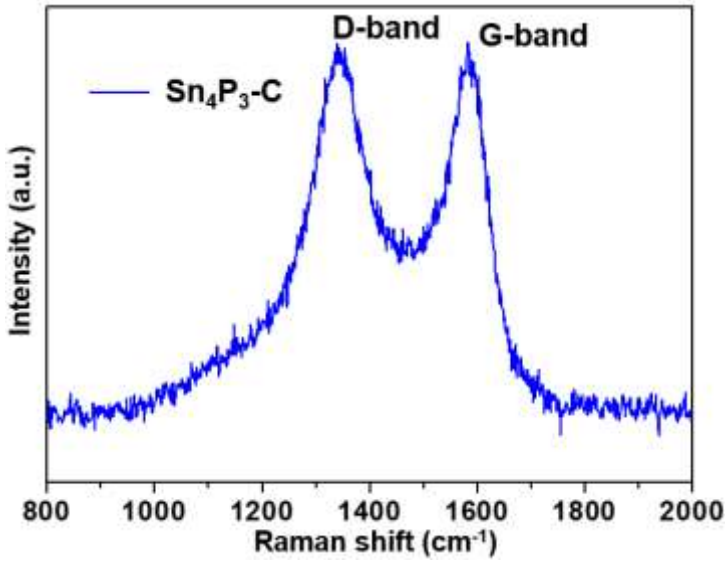

Fig. S7. Raman spectra of synthesized Sn_4P_3-C nanospheres.

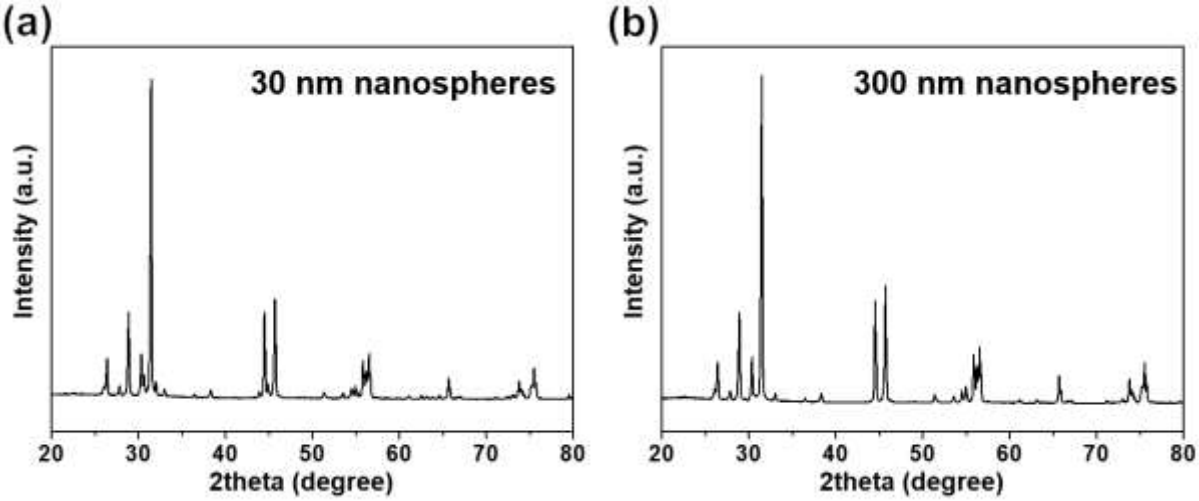

Fig. S8. XRD patterns of (a) 30 nm-sized and (b) 300 nm-sized Sn_4P_3-C nanospheres.

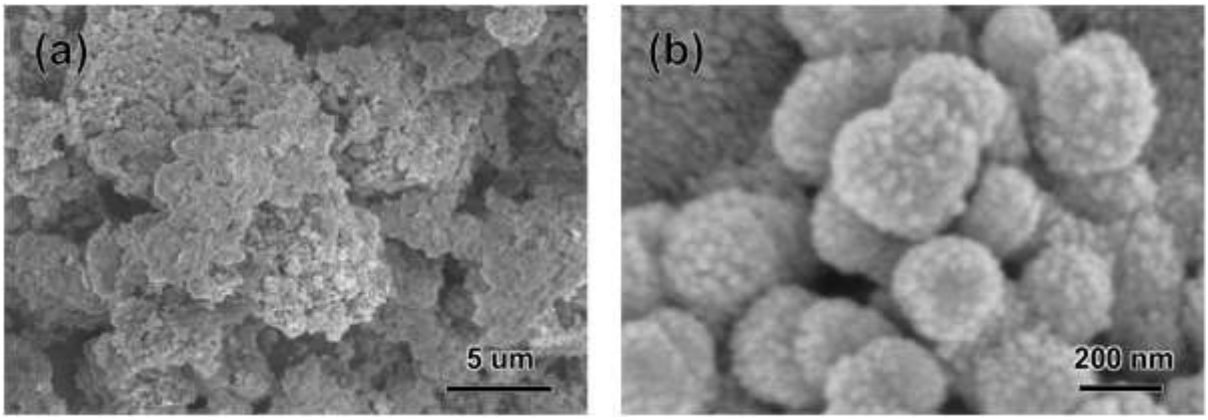

Fig. S9. SEM images of (a) 30 nm-sized nanosphere and (b) 300 nm-sized nanosphere electrodes after 50 cycles at 1000 mA g^{-1} for LIBs.

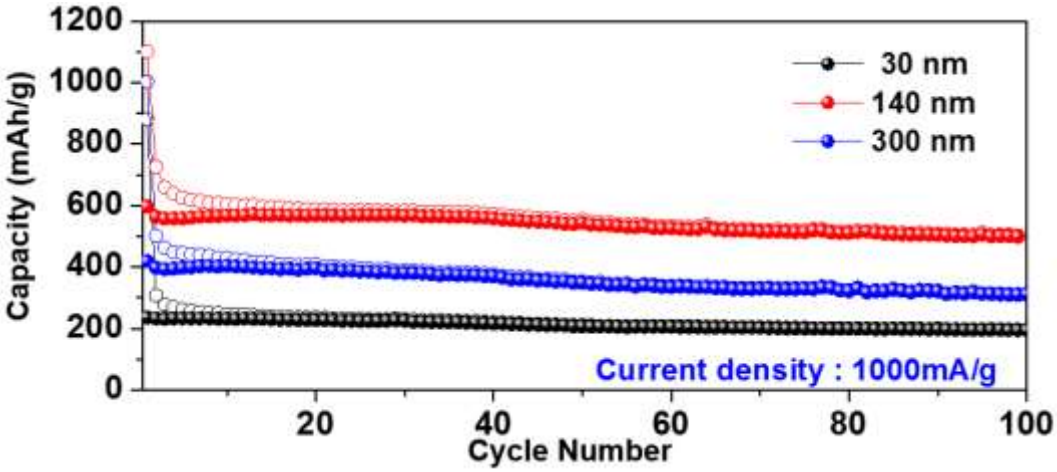

Fig. S10. Cyclability of 30 nm, 140 nm, and 300 nm-sized Sn_4P_3-C nanosphere electrodes at 1000 mA g^{-1} for SIB anode.

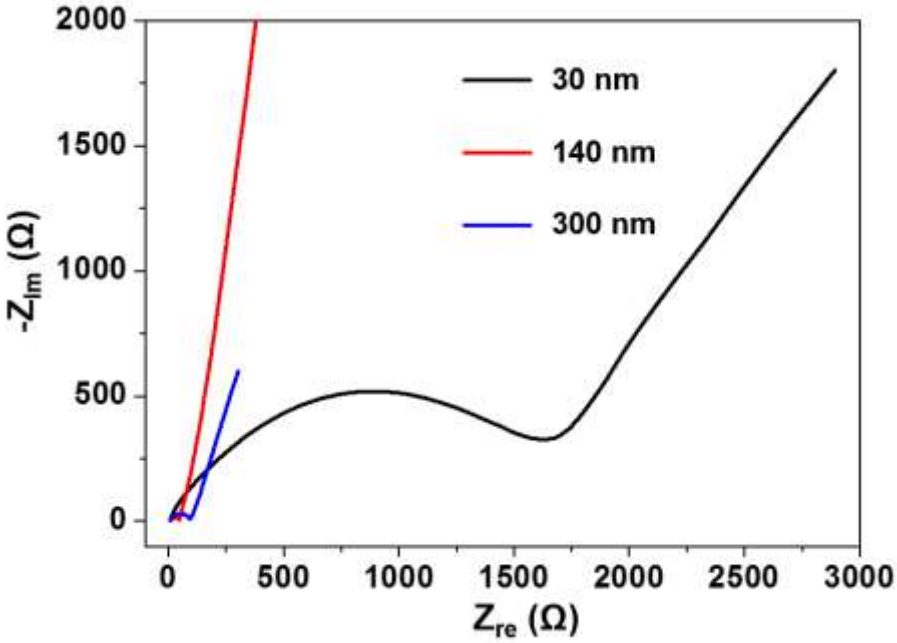

Fig. S11. Electrochemical impedance spectroscopy (EIS) results of 30 nm, 140 nm, and 300 nm-sized Sn_4P_3-C nanosphere electrodes.

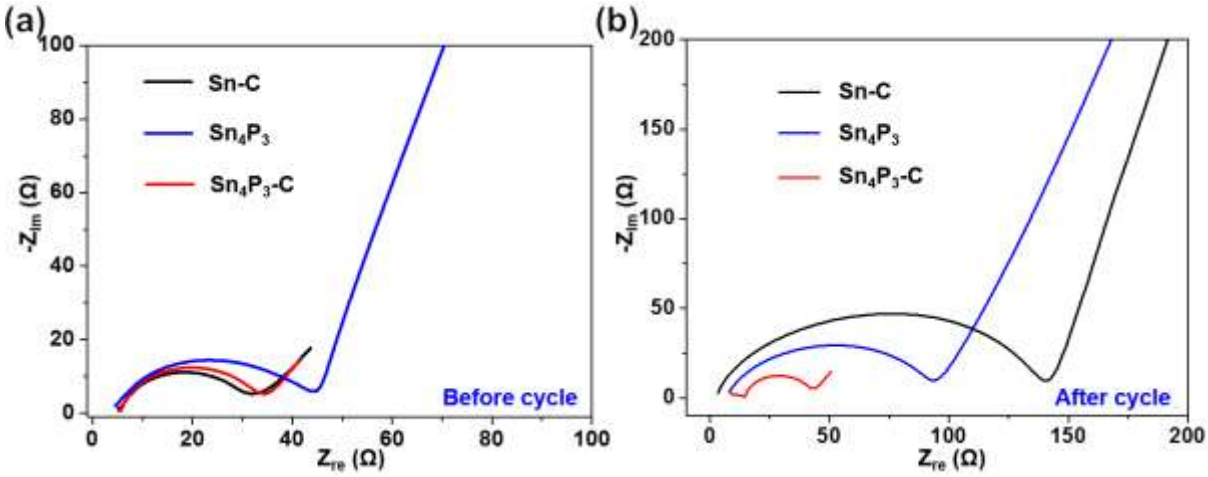

Fig. S12. Electrochemical impedance spectroscopy (EIS) results of Sn-C, Sn_4P_3, and Sn_4P_3-C electrodes (a) before and (b) after 50 cycles.

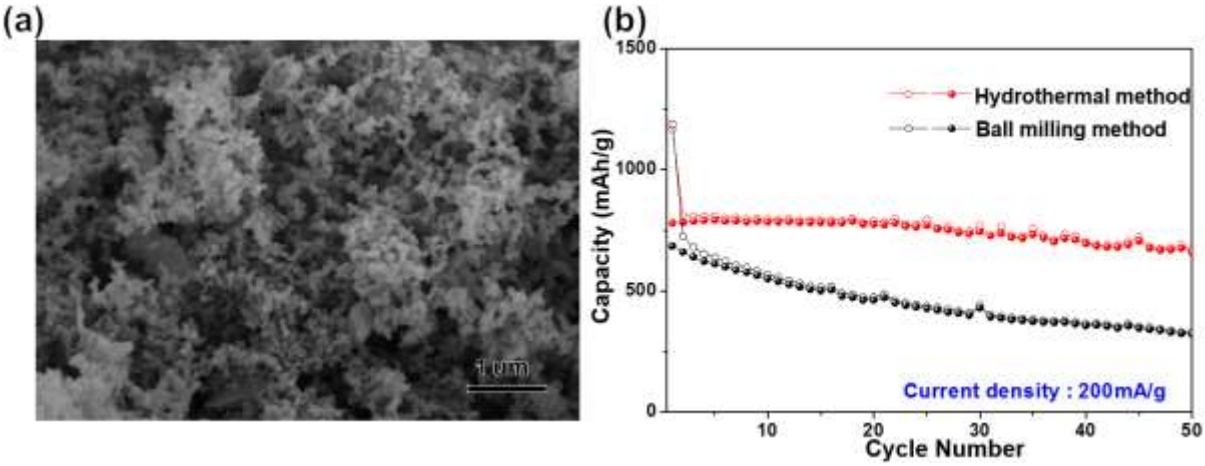

Fig. S13. (a) SEM image of Sn_4P_3/C nanocomposite synthesized by a ball milling method and (b) cyclability of Sn_4P_3-C nanosphere and Sn_4P_3/C nanocomposite electrode at 200 mA g^{-1} for SIB anode.

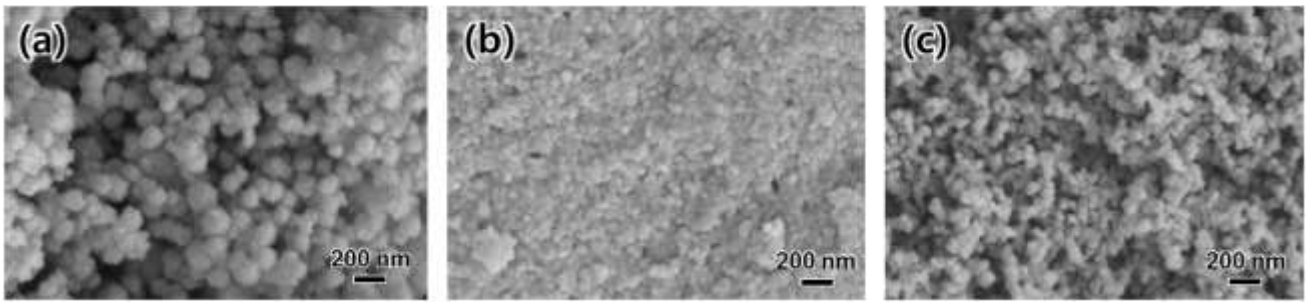

Fig. S14. SEM images of (a) pristine Sn_4P_3-C nanospheres, (b) cycled Sn_4P_3-C nanospheres without DMC washing process, and (c) Sn_4P_3-C nanospheres after DMC washing process.

Table 1. The electrochemical performance of some Sn_4P_3 anode materials for SIB.

Samples	Current density ($mA\ g^{-1}$)	Cycle number	Capacity ($mA\ h\ g^{-1}$)	Ref.
$Sn_{4+x}P_3$	100	100	465	[1]
Sn_4P_3-C nanosphere	1500	400	360	[2]
Sn_4P_3	100	50	605	[3]
Sn_4P_3/RGO	1000	1500	362	[4]
Sn_4P_3/C	100	150	500	[5]
Sn_4P_3	100	100	650	[6]
Sn_4P_3	100	320	442	[7]
Sn_4P_3/C	2000	500	368	[8]
Sn_4P_3-P @Graphene	2000	1000	371	[9]
Sn_4P_3-C	2000	2000	420	This work

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