Electronic Supplementary Material (ESI) for CrystEngComm.

Supporting information

The transformation of anatase TiO_2 to $TiSe_2$ to form TiO_2-$TiSe_2$ composites for Li^+/Na^+ storage with improved capacities

Pengchao Li, Changmiao Chen, Zhao Huang, Yong Cai and Ming Zhang*.

Key Laboratory for Micro/Nano Optoelectronic Devices of Ministry of Education & Hunan Provincial Key Laboratory of Low-Dimensional Structural Physics and Devices, School of Physics and Electronics, Hunan University, Changsha 410082.

*Email: zhangming@hnu.edu.cn

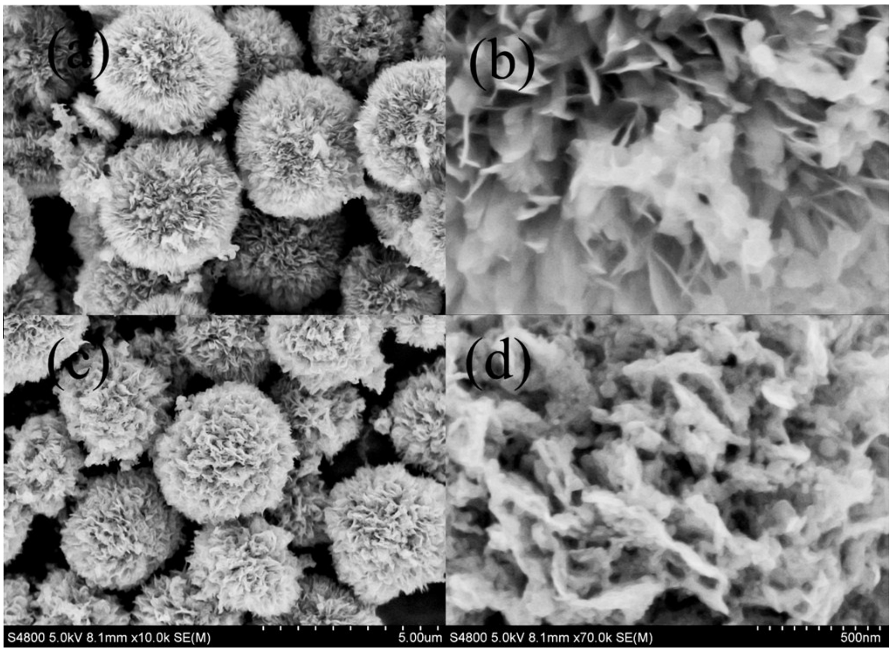

Figure S1. The SEM of TiO_2-A. a-b) pure TiO_2-A; c-d) TiO_2-A (Se).

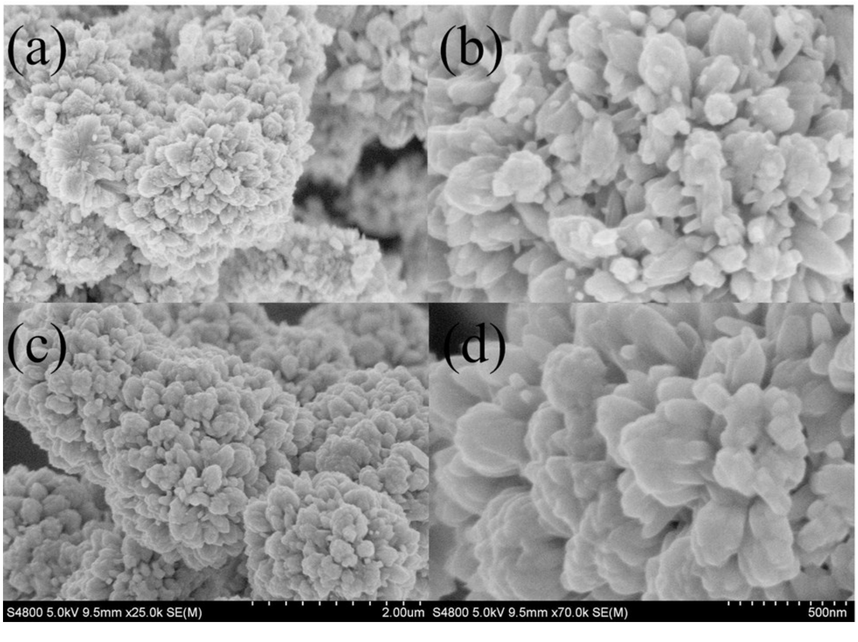

Figure S2. The SEM of TiO_2-R. a-b) pure TiO_2-R; c-d) TiO_2-R (Se).

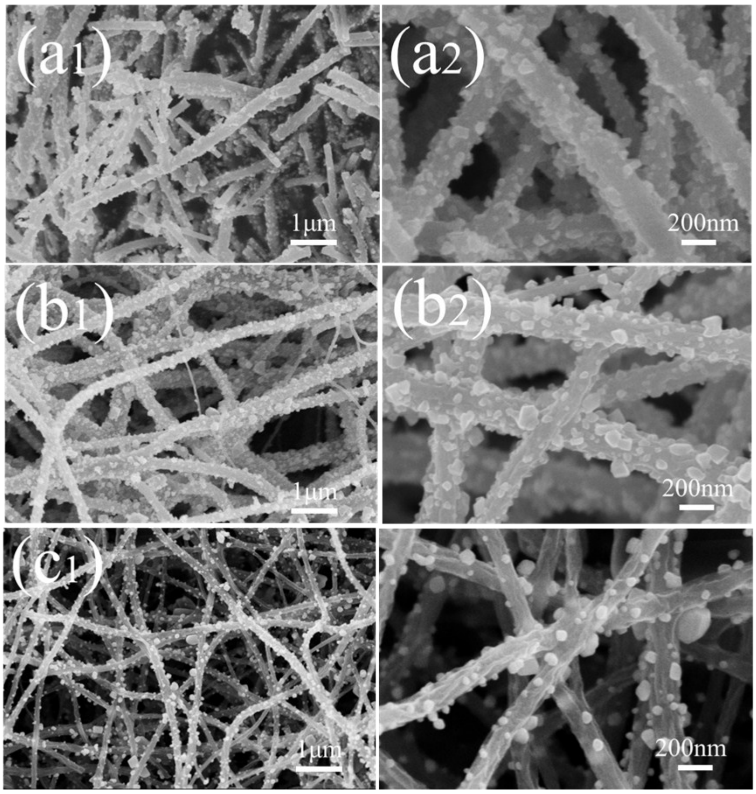

Figure S3. The SEM image of TiO_2@CNFs and selenium powder (at a mass ratio of 1:3) are mixed to selenylation at different temperatures. a1-a2) TiO_2-$TiSe_2$-CNFs-400-3h; b1-b2) TiO_2-$TiSe_2$-CNFs-500-3h; c1-c2) TiO_2-$TiSe_2$-CNFs-700-3h.

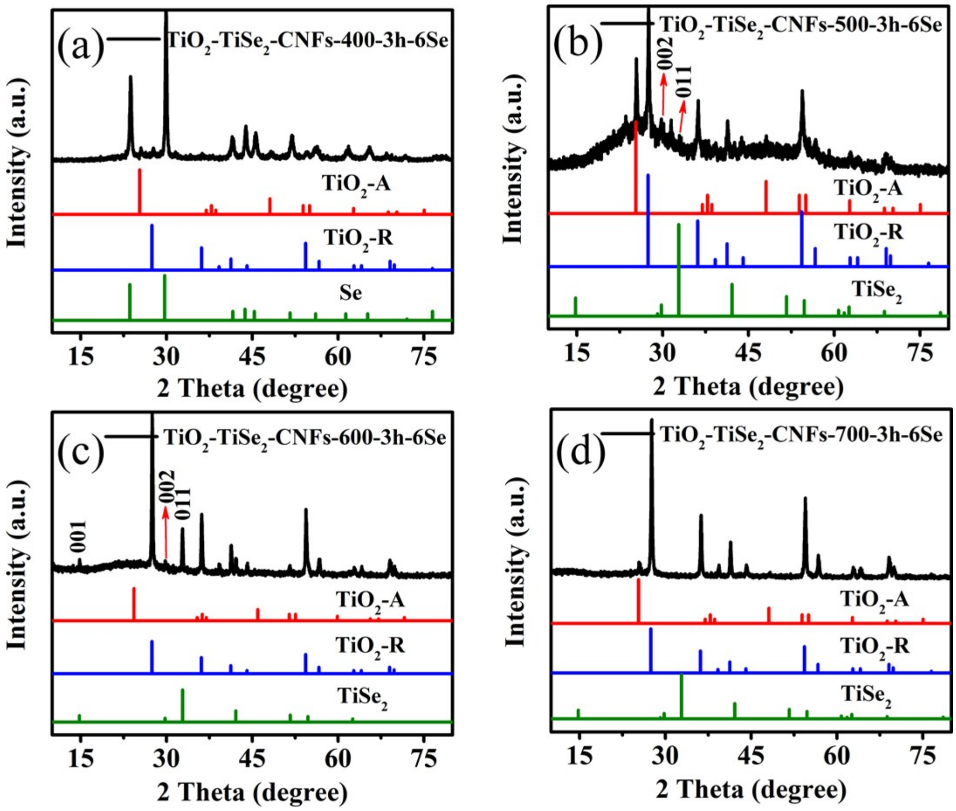

Figure S4. XRD pattern of TiO_2-$TiSe_2$-CNFs. The TiO_2-CNFs are mixed with selenium Powder (weight ratio=1:6) and selenylation at different temperatures. a) TiO_2-$TiSe_2$-CNFs-400-3h-6Se; b) TiO_2-$TiSe_2$-CNFs-500-3h-6Se; c) TiO_2-$TiSe_2$-CNFs-600-3h-6Se; d) TiO_2-$TiSe_2$-CNFs-700-3h-6Se.

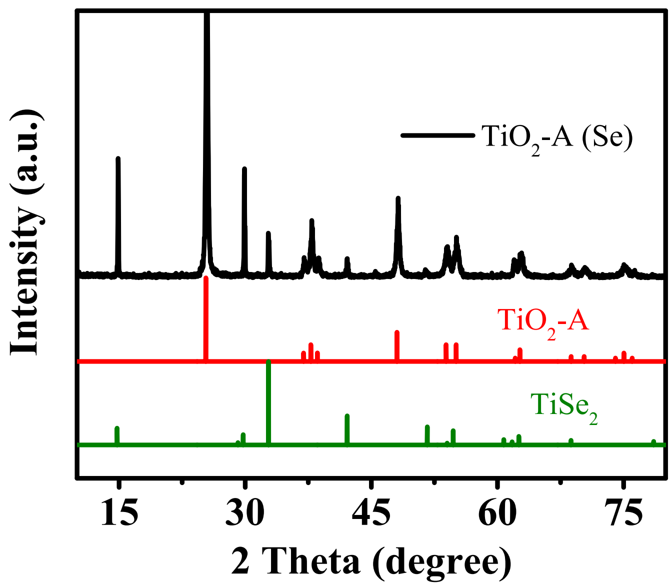

Figure S5. XRD patterns of TiO_2-A (Se). The TiO_2-A (Se) is obtained by annealing TiO_2-A at 400°C under Ar/H_2 atmosphere, and then the TiO_2-A is selenide (TiO_2-A: selenium powder = 1:6, weight ratio) at 600°C with Ar/H_2.

Table S1. The Average size of the TiO_2-A, TiO_2-R and $TiSe_2$ crystallites

Samples	TiO_2-A(nm)	TiO_2-R(nm)	$TiSe_2$(nm)
TiO_2-CNFs	8.43	/	/
TiO_2-$TiSe_2$-CNFs-400-3h	19.99	17.62	42.44
TiO_2-$TiSe_2$-CNFs-500-3h	30.15	26.18	45.51
TiO_2-$TiSe_2$-CNFs-600-3h	32.74	36.27	48.75

TiO_2-$TiSe_2$-CNFs-700-3h	41.30	41.48	/

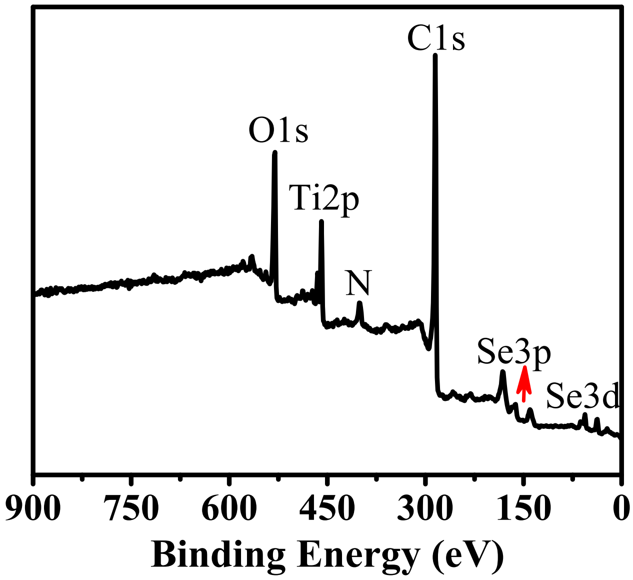

Figure S6. XPS patterns of TiO_2-$TiSe_2$-CNFs-600 compound.

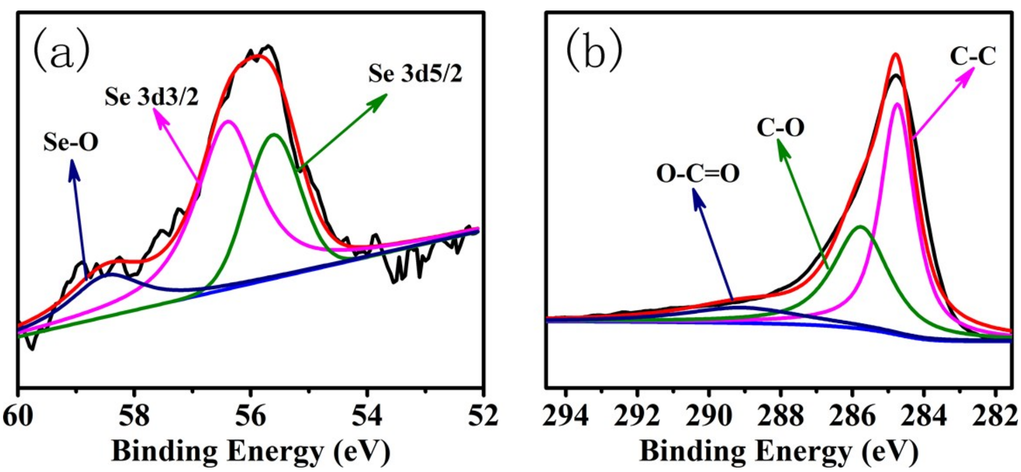

Figure S7. XPS spectra of the Se-CNFs of (a) Se 3d and (b) C 1s XPS spectrum.

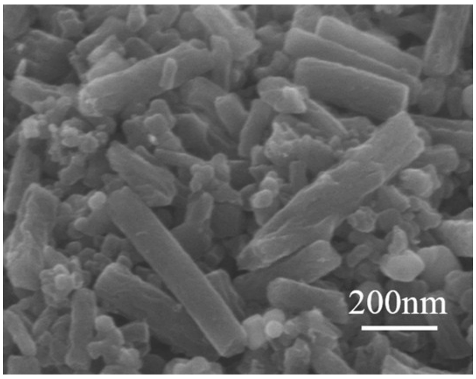

Figure S8. The SEM image of TiO_2-$TiSe_2$-CNFs-600-3h after 200 cycles as LIBs.

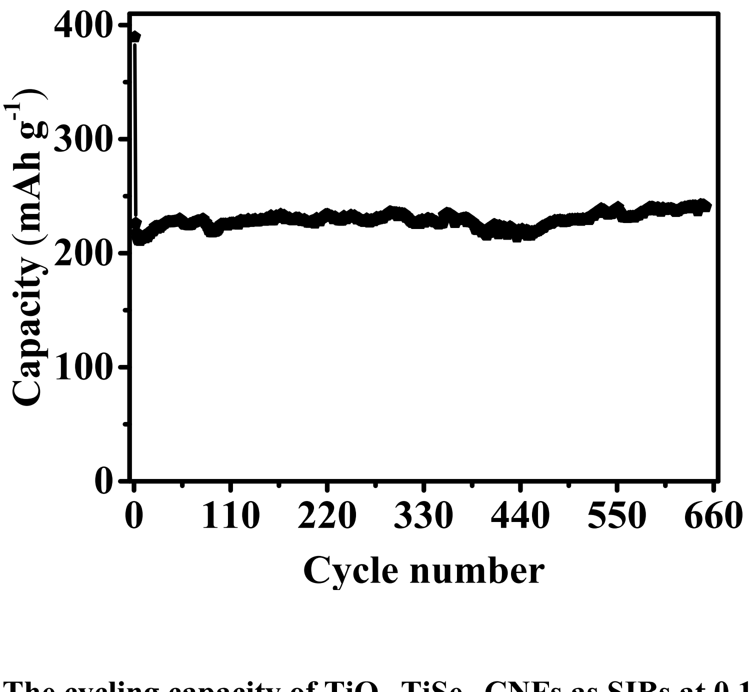

Figure S9. The cycling capacity of TiO_2-$TiSe_2$-CNFs as SIBs at 0.1 A g^{-1}.

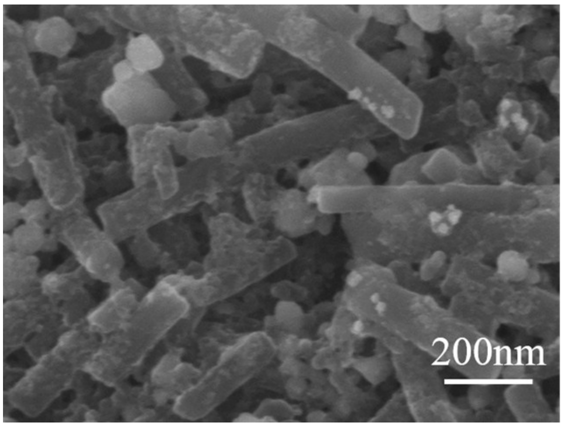

Figure S10. The SEM image of TiO_2-$TiSe_2$-CNFs-600-3h after 200 cycles as SIBs.

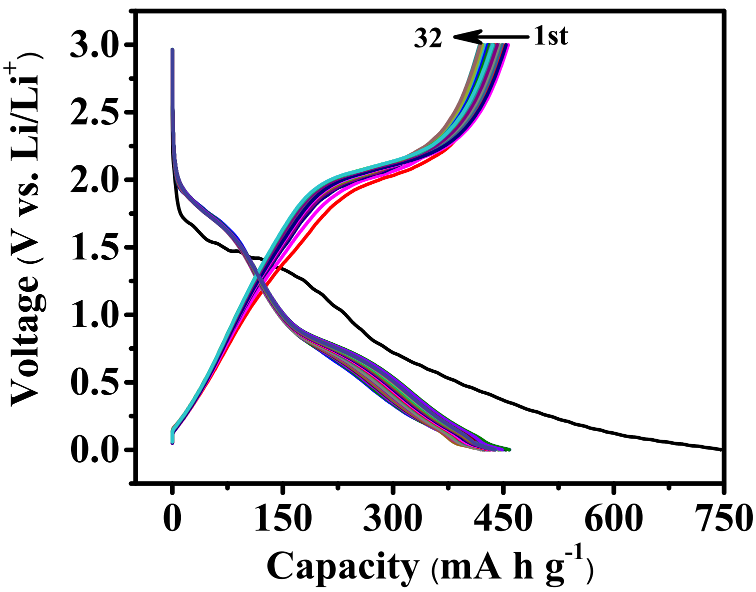

Figure S11. Charging and discharging curves of TiO_2-$TiSe_2$-CNFs composite as LIBs at the current density of 100 mA/g.

Table S2. The electrochemical performances of reported TiO_2 and $TiSe_2$ for LIBs and SIBs.

Materials	First discharge capacity/ current density	capacity (mA h/g) number/current density (A/g)	Rate capacity (mA h/g) / current density (A/g)	reference
Porous anatase TiO_2	/	166.2/500/0.168 106.5/500/0.84	/	[1]
Nanoporous Anatase TiO_2	204/0.17	151.9/60/0.17 A/g	164.9/0.17; 151.7/0.34	[2]
Anatase TiO2 Nanotubes	297/0.025	235/ 30/0.025	205/1.25; 180/2.5	[3]
Mesoporous Anatase TiO_2 Nanospheres/Graphene	332/16.8	200/100/168	/	[4]
Anatase/graphene oxide	506/0.168	148/ 500/0.168	/	[5]
S-doped $TiSe_2$/Fe_3O_4	1150.6/ 0.1	707.4/100/ 0.1 432.3/ 200/2	739.8/0.1; 671.8/0.2; 623.6/0.5;565.3 /1; 495.4/2	[6]
$TiSe_2$ nanosheets	/	150/500/0.3 115/ 500/ 0.5	150/0.1; 140/0.2, 136/0.5; 131/1;125/2	[7]
TiO_2-$TiSe_2$-CNFs-LIBs	746/0.1	470/200/ 0.1	421/0.1;308/0.2;235/0.5;193/1	This work
TiO_2-$TiSe_2$-CNFs-SIBs	389.7/0.1	230/600/0.1	189/0.1;165/0.2;145/0.5; 128/1	This work

Reference

1. Z. Wang, X. Li, H. Xu, Y. Yang, Y. Cui, H. Pan, Z. Wang, B. Chen and G. Qian, *Journal of Materials Chemistry A*, 2014, **2**, 12571-12575.
2. J. Ye, W. Liu, J. Cai, S. Chen, X. Zhao, H. Zhou and L. Qi, *Journal of the American Chemical Society*, 2011, **133**, 933-940.
3. J. Kim and J. Cho, *Journal of the Electrochemical Society*, 2007, **154**, A542-A546.
4. N. Li, G. Liu, C. Zhen, F. Li, L. Zhang and H. M. Cheng, *Advanced Functional Materials*, 2011, **21**, 1717-1722.
5. J. H. Kirn, W. Choi, H.-G. Jung, S. H. Oh, K. Y. Chung, W. I. Cho, I. H. Oh and I. W. Nah, *Journal of Alloys and Compounds*, 2017, **690**, 390-396.
6. J. Yang, Y. Zhang, Y. Zhang, J. Shao, H. Geng, Y. Zhang, Y. Zheng, M. Ulaganathan, Z. Dai and B. Li, *Small*, 2017, **13**.
7. D. Zhang, G. Zhao, P. Li, Y. Zhang, W. Qiu, J. Shu, Y. Jiang, S. X. Dou and W. Sun, *Chemistry-A European Journal*, 2017.