Electronic Supplementary Information (ESI) for

MoS_2@SnS heterostructure for sodium-ion storage with enhanced kinetics

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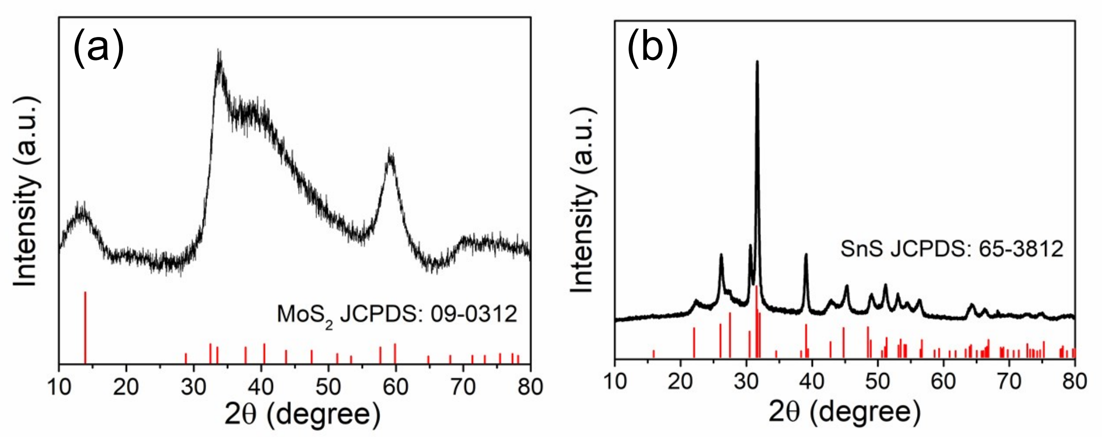

Fig. S1. XRD patterns of (a) MoS_2 nanospheres and (b) SnS microflowers.

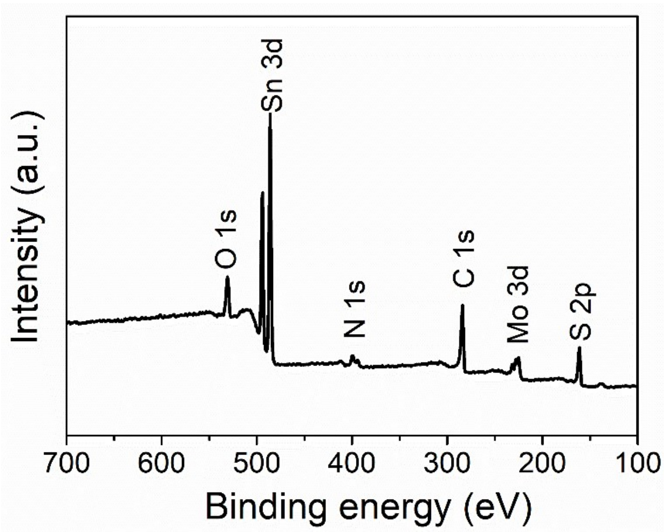

Fig. S2. Survey XPS spectrum of MoS_2@SnS heterostructure.

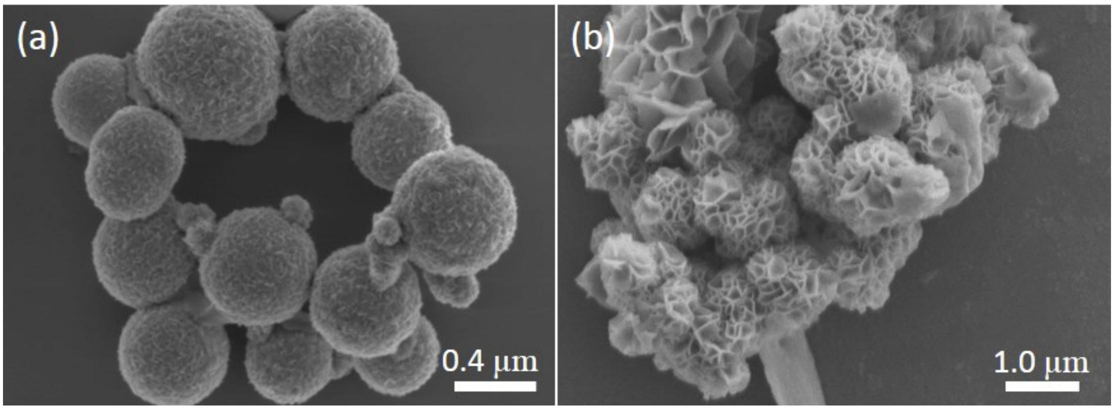

Fig. S3. SEM images of (a) MoS_2 nanospheres and (b) SnS microflowers.

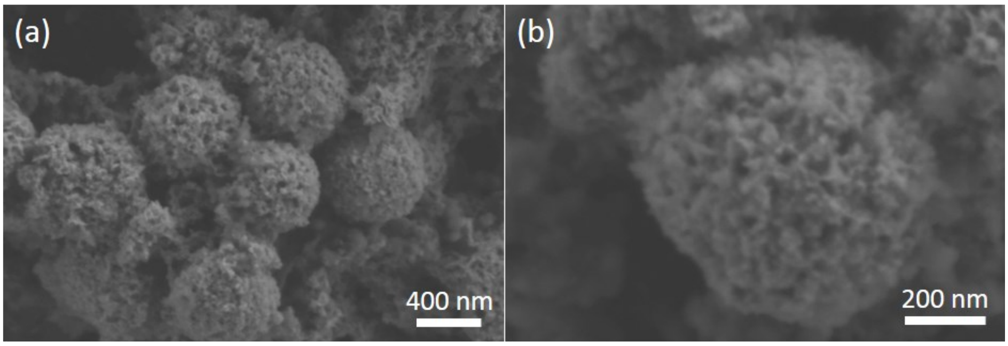

Fig. S4. SEM images of the MoS_2@SnS heterostructure after testing at 1.0 A g^{-1} for 100 cycles.

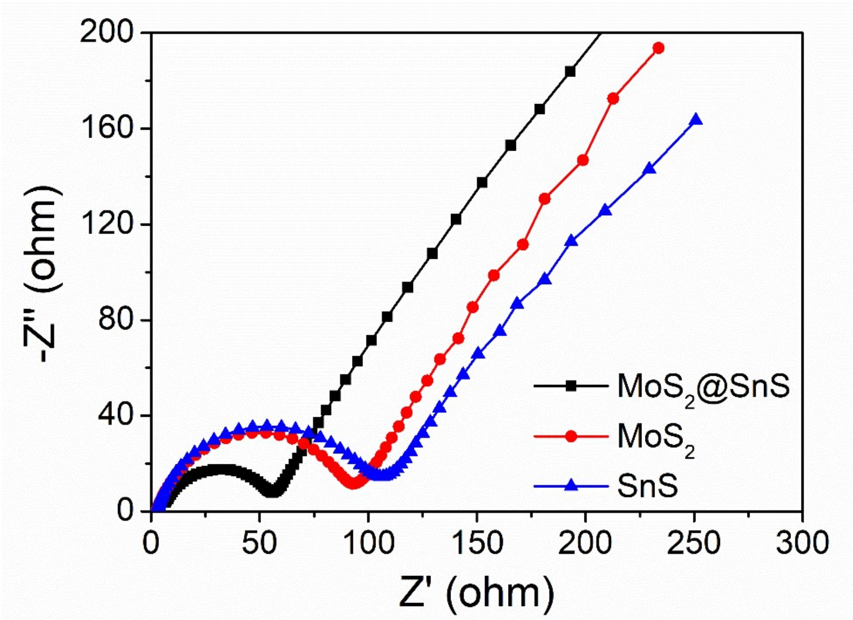

Fig. S5. Nyquist plots of SnS microflowers, MoS_2 nanospheres, and MoS_2@SnS heterostructure electrodes in the frequency range from 100 kHz to 5 mHz before cycling.

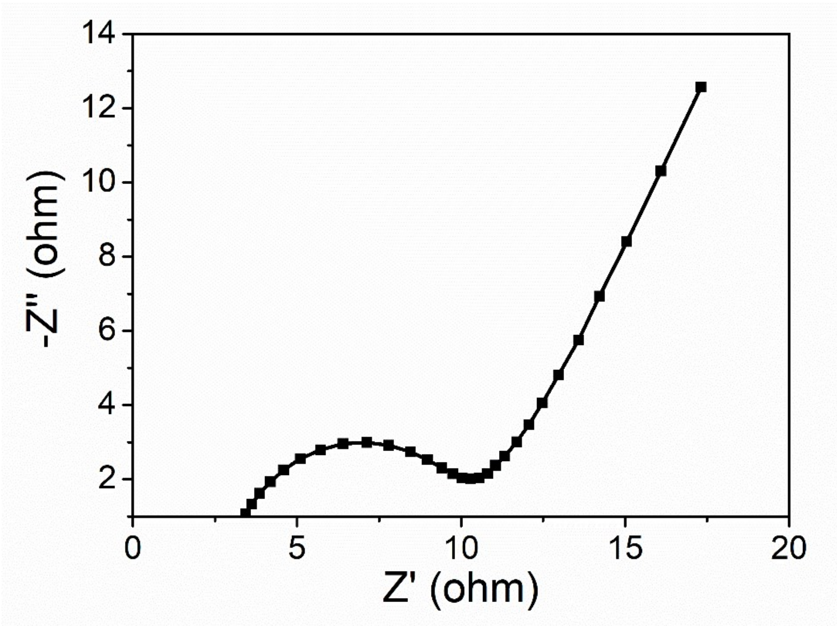

Fig. S6. Nyquist plot of MoS_2@SnS heterostructure electrode after testing at 0.1 A g^{-1} for 100 cycles.

Table S1. Comparison of sodium-ion storage performances of MoS_2@SnS heterostructure electrode in our work with MoS_2 or SnS nanostructures from recent literatures.

Electrodes	Rate capability	Cycling performance
MoS_2 nanosheets [1]	386 mAh g^{-1} at 0.32 A g^{-1}	644 mAh g^{-1} after 100 cycles at 0.04 A g^{-1}
MoS_2/graphene[2]	352 mAh g^{-1} at 0.64 A g^{-1}	227 mAh g^{-1} after 50 cycles at 0.32 A g^{-1}
MoS_2/carbon [3]	390 mAh g^{-1} at 1.34 A g^{-1}	520 mAh g^{-1} after 50 cycles at 0.67 A g^{-1}
MoS_2 nanoflowers [4]	195 mAh g^{-1} at 10 A g^{-1}	350 mAh g^{-1} after 300 cycles at 0.05 A g^{-1}
MoS_2/graphene [5]	247.2 mAh g^{-1} at 1.25 A g^{-1}	386 mAh g^{-1} after 30 cycles at 0.125 A g^{-1}
SnS hollow nanofibers [6]	228 mAh g^{-1} at 2 A g^{-1}	289.4 mAh g^{-1} after 500 cycles at 1 A g^{-1}
SnS QNDs@NC [7]	172 mAh g^{-1} at 4 A g^{-1}	298 mAh g^{-1} after 500 cycles at 0.1 A g^{-1}
SnS-SnS_2 [8]	110 mAh g^{-1} at 5 A g^{-1}	290.1 mAh g^{-1} after 200 cycles at 0.1 A g^{-1}
SnS/C nanofibers [9]	206 mAh g^{-1} at 4 A g^{-1}	548 mAh g^{-1} after 500 cycles at 0.5 A g^{-1}
Our work	**556 mAh g^{-1} at 5 A g^{-1}**	**566 mAh g^{-1} after 500 cycles at 1 A g^{-1}**

Reference

[1] D. Su, S. Dou, G. Wang, *Adv. Energy Mater.,* 2015, **5**, 1401205.

[2] Y.X. Wang, S.L. Chou, D. Wexler, H.K. Liu, S.X. Dou, *Chem.,* 2014, **20**, 9607-9612.

[3] J. Wang, C. Luo, T. Gao, A. Langrock, A.C. Mignerey, C. Wang, *Small,* 2015, **11**, 473-481.

[4] Z. Hu, L. Wang, K. Zhang, J. Wang, F. Cheng, Z. Tao, J. Chen, *Angew. Chem. Int. Ed.,* 2014, **53**, 12794-12798.

[5] X. Xie, Z. Ao, D. Su, J. Zhang, G. Wang, *Adv. Funct. Mater.,* 2015, **25**, 1393-

1403.

[6] H. Jia, M. Dirican, N. Sun, C. Chen, P. Zhu, C. Yan, X. Dong, Z. Du, J. Guo, Y. Karaduman, J. Wang, F. Tang, J. Tao and X. Zhang, *Chem. Commun.*, 2019, **55**, 505-508.

[7] G. K. Veerasubramani, M. S. Park, J. Y. Choi and D. W. Kim, *ACS Appl. Mater. Interfaces*, 2020, **12**, 7114-7124.

[8] S. Zhang, W. Lv, D. Qiu, T. Cao, J. Zhang, Q. Lin, X. Chen, Y. He, F. Kang and Q. Yang, *J. Mater. Chem. A*, 2019, **7**, 10761-10768.

[9] J. Xia, L. Li, J. Xie, H. Yan, Y. Yuan, Y. Z., S. Nie, J. Pan, X. Wang, G. Cao *Energy Storage Mater.,* 2019, **17**, 1-11.