Hybrid Cathode Architectures for Lithium Batteries based on TiS_2 and Sulfur

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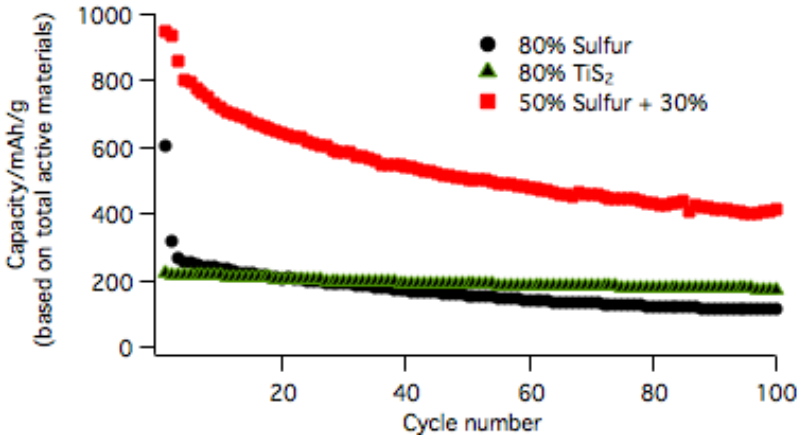
Supporting information



(a)

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Electronic supporting information (ESI) available.

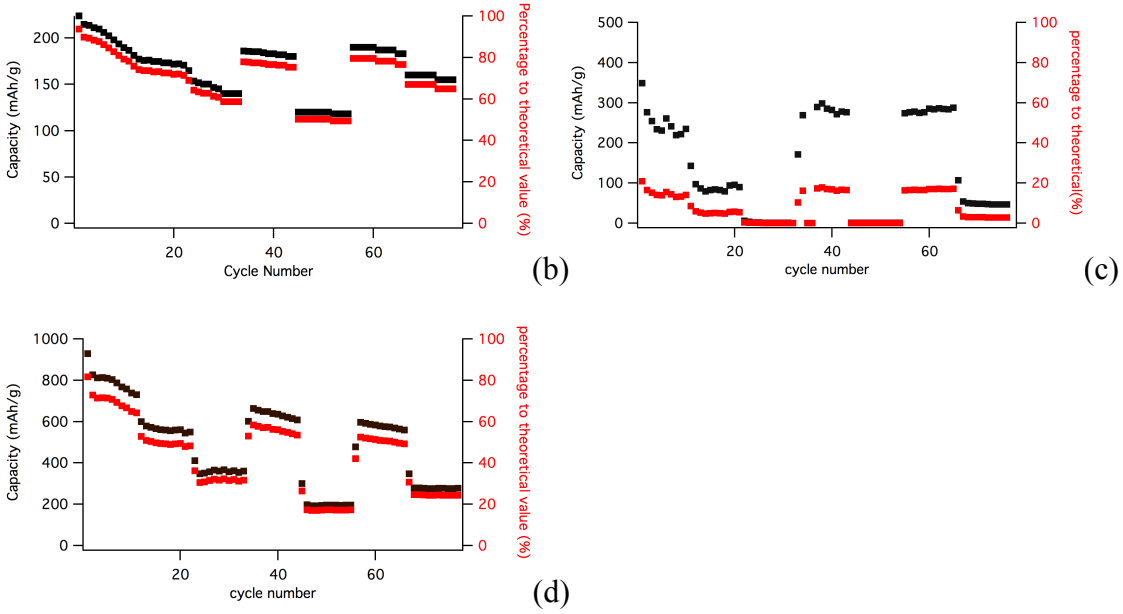


Figure S1. (a) Cycling performance of TiS_2, sulfur and TiS_2/S_8 hybrid electrode at 0.1C. Performance of (b) TiS_2 electrode, (c) sulfur electrode (d) TiS_2/S_8 hybrid cycled at various current rates (0.1C, 0.2C, 0.5C, 0.1C, 1C, 0.1C, 0.2C).

Cathode materials	First discharge capacity (mAh/g)*	Capacity after 30 cycles (mAh/g)*	Degradation rate per cycle (%)	Utilization rate(%)+
80% Sulfur cathode	603	189	2.3	36
50% Sulfur + 30%TiS_2 cathode	950	600	1.2	84

Table S1. Comparison of the performance of different cathode materials.

* The capacity is calculated based on the weight of the total active materials.

+ Utilization rate = Experimental Capacity/Theoretical Capacity.

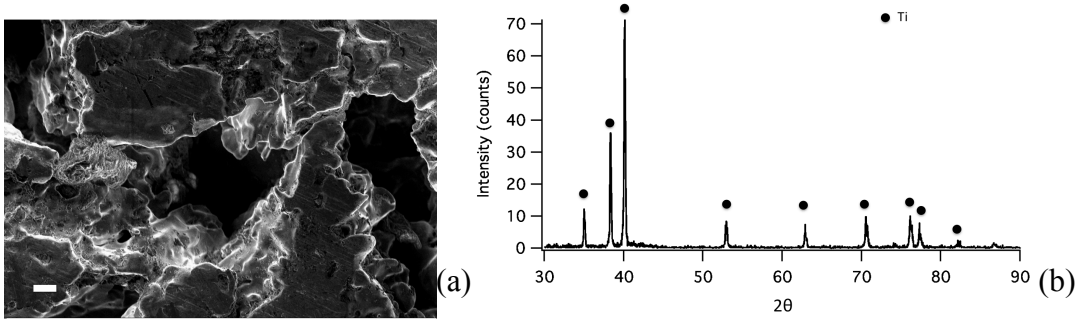


Figure S2. (a) SEM of Ti metal foam. Scale bar= 20 µm .(b) XRD analysis of Ti metal foam.

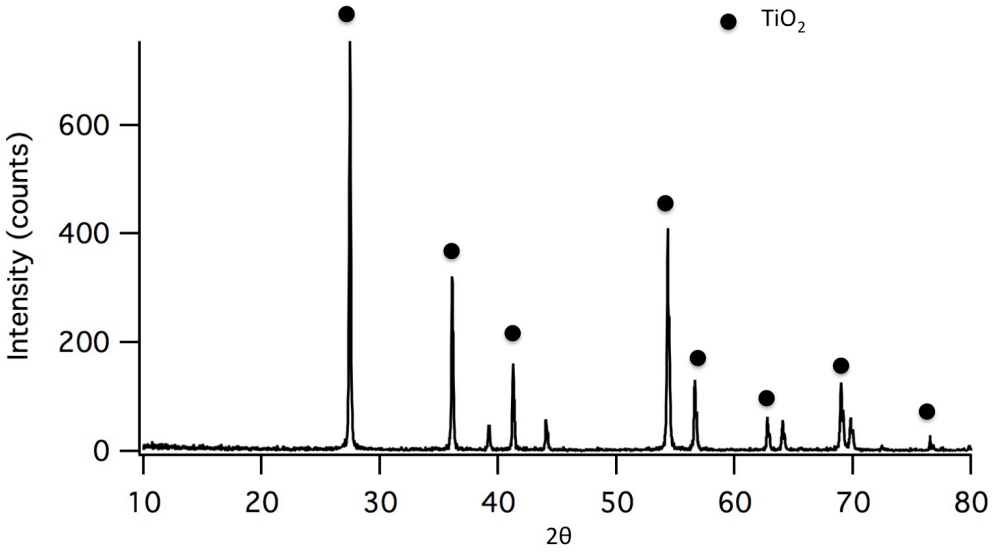


Figure S3. XRD analysis of the TGA products.

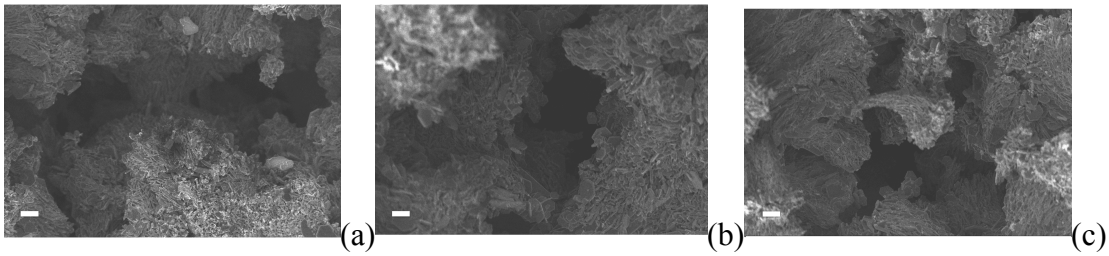
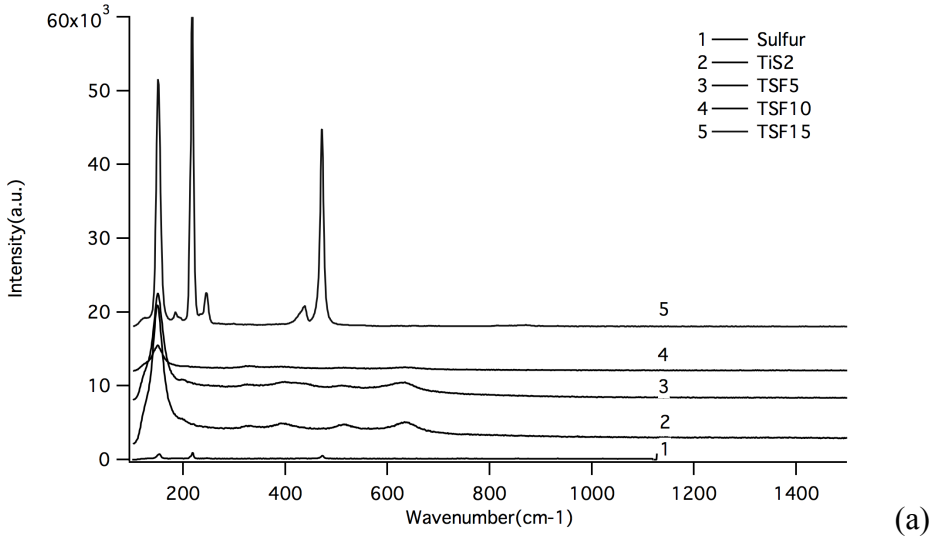


Figure S4. SEM images of (a)TSF5; (b)TSF10; (c) TSF15. Scale bar=20 μm.



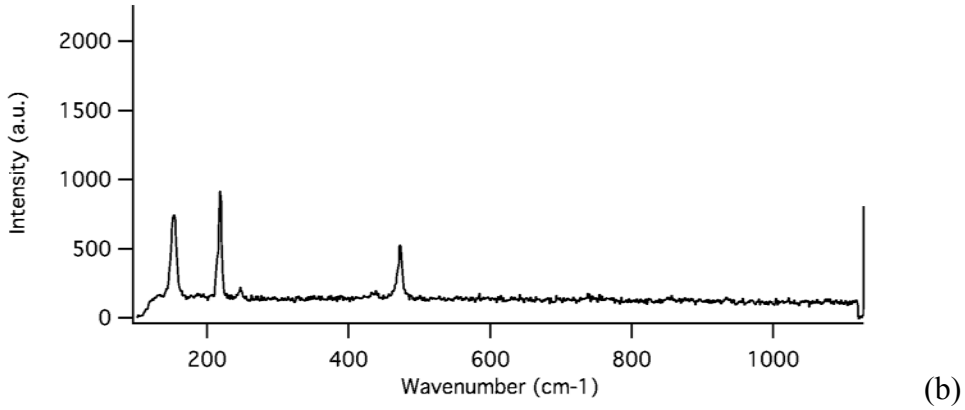


Figure S5. (a) Comparison of Raman spectra of 1. Sulfur powder. 2. TiS_2 powder. 3. TSF5. 4. TSF10. 5. TSF15. (b) Zoom-in spectra of sulfur.

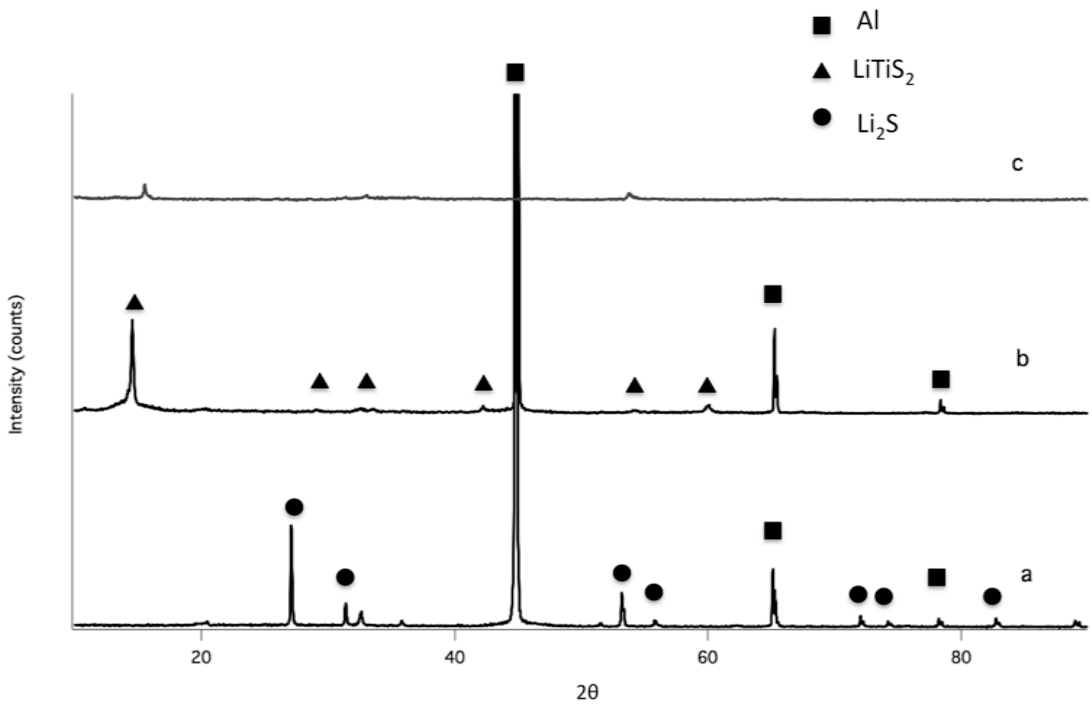
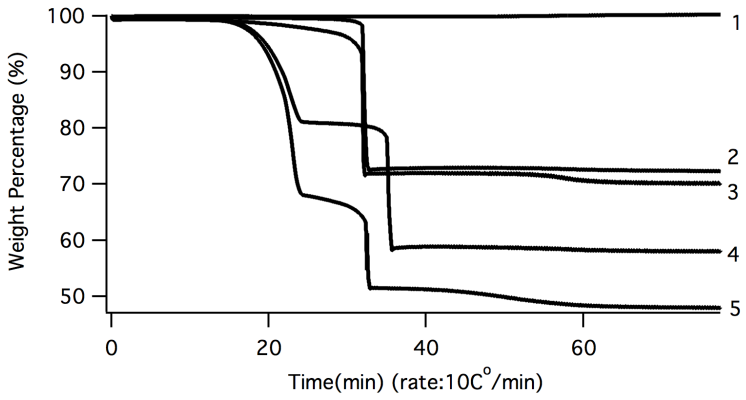


Figure S6. XRD analysis of the discharge products of (a) Sulfur electrode. (b) TiS_2 electrode. (c) TSF15.

Method 1

Method to determine content of Sulfur, TiS_2 and Ti metal content using Thermogravimetric analysis (TGA).



1. Ti metal
2. TiS_2
3. TSF5
4. TSF10
5. TSF15

Use curve4 as an example. Set the percentage% of sulfur, TiS_2 and Ti as x, y, z respectively.

x+y+z=100

y+z=80

y*79.866(TiO_2)/111.997(TiS_2)+z=59

x=20;

y=73;

z=7.

Method 2

Estamination of the capacity based on the mass of the whole electrode

The areal weight with 4.7mg/cm^2 of Al current collector is used here to calculate S wt% in total cathode weight.

For example, in reference 6, sulfur loading is 1.13 mg/cm^2, percentage of sulfur in the electrode slurry is 59 wt% and a capacity ~ 1100 mAh/g is obtained in 20th cycle.

Capacity based on the whole electrode =

*1100mAh/g*1.13mg/cm^21.13mg/cm^2/0.59+4.7mg/cm^2* = 181 mAh/g