Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.

Supporting Information

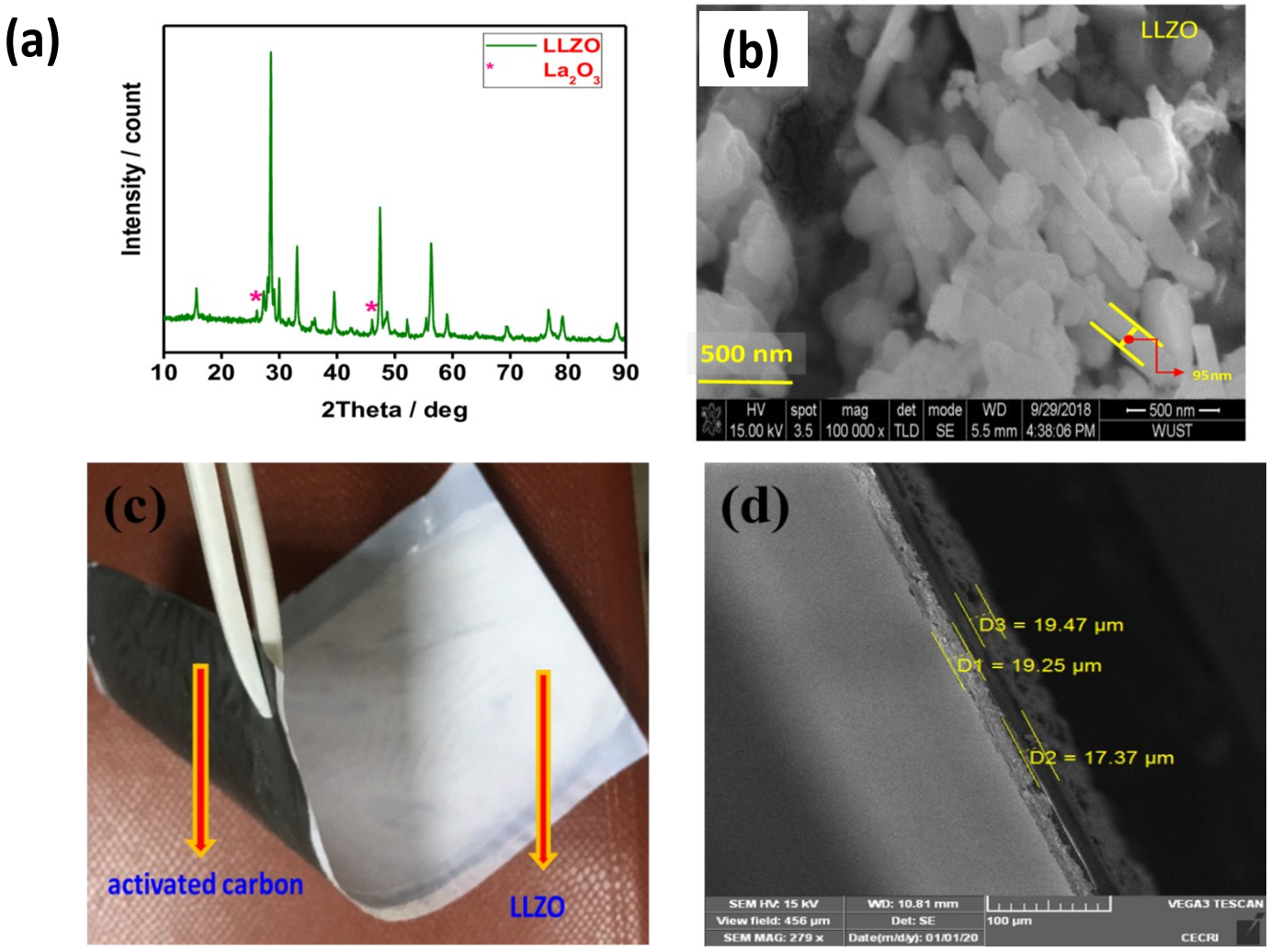

Figure SI 1. (a) XRD patterns of Li7La3Zr2O12 * indicates La2O3 impurity phase (b) SEM image Li7La3Zr2O12 (c) Flexible trilayer membrane (d) Cross-sectional SEM

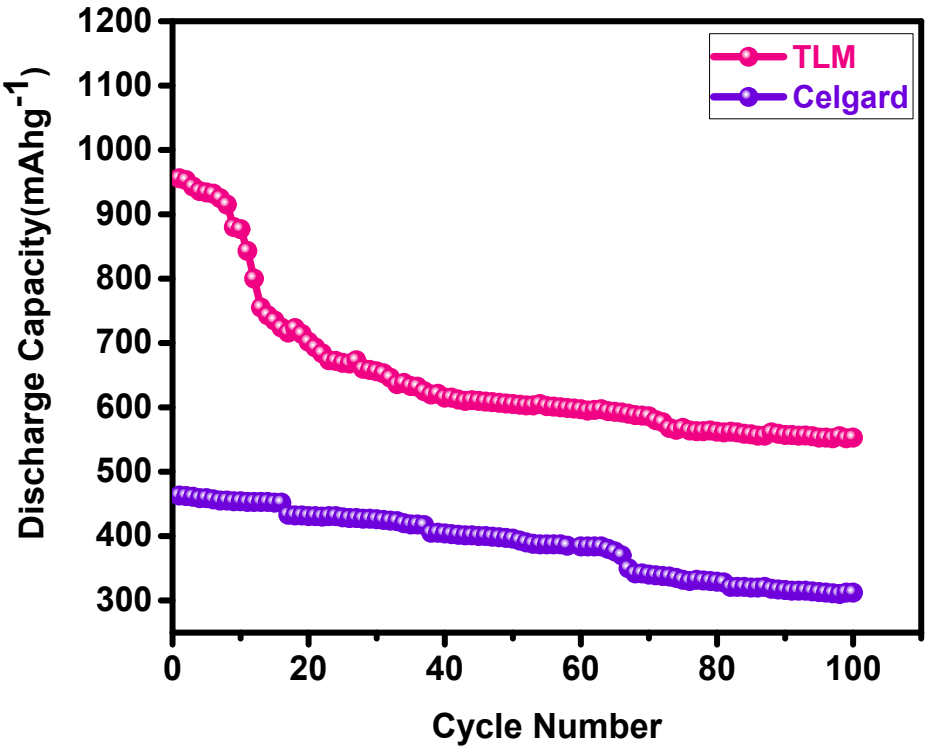

Figure SI 2. Discharge capacity vs. cycle number for Li S cell with trilayer membrane at

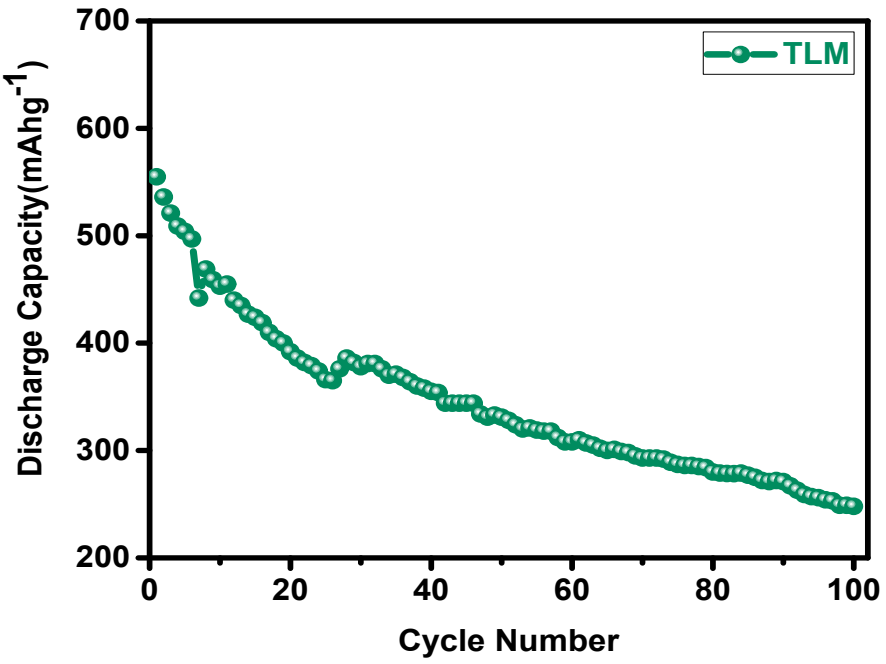

Figure SI 3. Discharge capacity vs. cycle number for Li S cell with trilayer membrane at 0.2C- rate (Trilayer membrane with Li7La3Zr2O12 facing cathode while activated

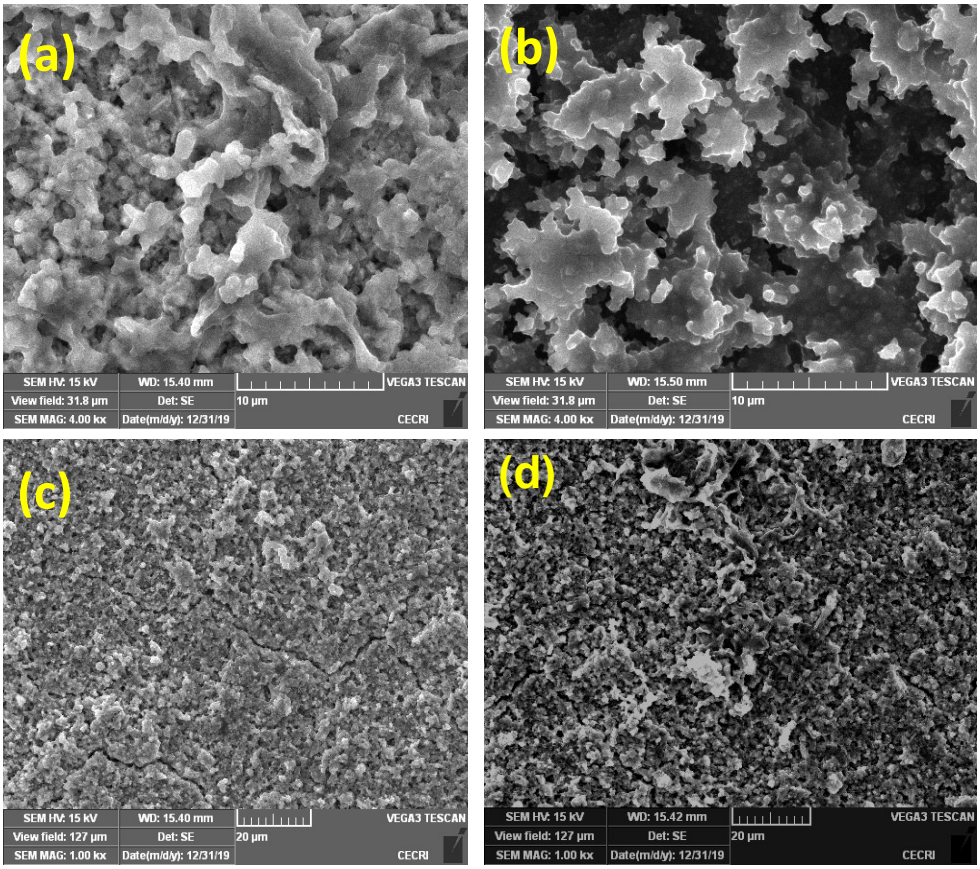

Figure SI 4. SEM images of Li7La3Zr2O12 (a) before cycling (b) after cycling

SI 5 .Table 1. Comparison of permselective trilayer membranes properties with the present system

S.No	S - content (wt%)	Mass loading of S electrode (mg/cm^2)	Thickness of the coating layer (µm)	Mass of the coating layer (mg/cm^2)	Initial discharge capacity (mAh/g)	Reversible discharge capacity (mAh/g)	Number of cycles	Current density	Degradation rate per cycle (%).	Reference
1	75	0.75	25	1.32	1067.7	804.4	100	0.2 C	1.3	**1**
2	80	2.5(areal loading)	35	1	1110.4	801.6	300	0.5	NA	**2**
3	60	1.4	8	0.01	1020	709	100	0.2	0.3	**3**
4	63	1.5	20	0.12	920	NA	100	0.1	0.49 to 0.23	**4**
5	60	1	25	0.5	836	610	200	0.1	0.1	**5**
6	72	0.72	47	0.8	1370	620	100	0.1	2.20	**6**
7	80	1	NA	NA	1045	628	50	0.05	1.6	**7**
8	42	1	42	NA	1287	807.8	100	0.2	1.60	**8**
9	80	0.7	20	0.825	1382	924	200	0.1	1.4	**9**
10	70	1.7	35	0.9	1382	1015	200	0.2	0.1	**10**
11	80	0.9 and 4.5(areal loading)	36	0.8	956	553	100	0.2	1.9	**11**

References

1. R.Song.et.al.,*J. of Power Sources*,2016, **301**, 179-186.

2. G.Ma,et.al.,*J. Mater. Chem. A*, 2016, **4**,16968.

3. A.Manthiram ,et.al.,*J. Mater. Chem. A*, 2015, **3**,18829-18834.

4. F.Wei,et.al.,*ACS Nano* ,2015,**9**,3,3002-3011.

5. Y.Cuiet.al.,*Energy.Environ.Sci.*,2014,**7**,3381-3390.

6. A.M.Stephan,et.al.,*Inorg.chem.front.,*2017,**4**,1013-1021.

7. Z.Luo,et.al.,*ACS Appl.Mater.Interfaces* ,2018,**10**,6,5534-5542.

8. H.F.Xiang,et.al., *Ionics* ,2015, **21**,981–986.

9. S.H.Yeon et.al.,*J.Mater.Chem.A*,2015,**3**,9461-9467.

10. L.Giebeler,et.al.,*J.Phys.Chem.C* ,2015,**119**,94580-4587.

11.The present work.