

## Highly conductive, sulfonated, UV-crosslinked separators for Li-S batteries

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### Supporting information

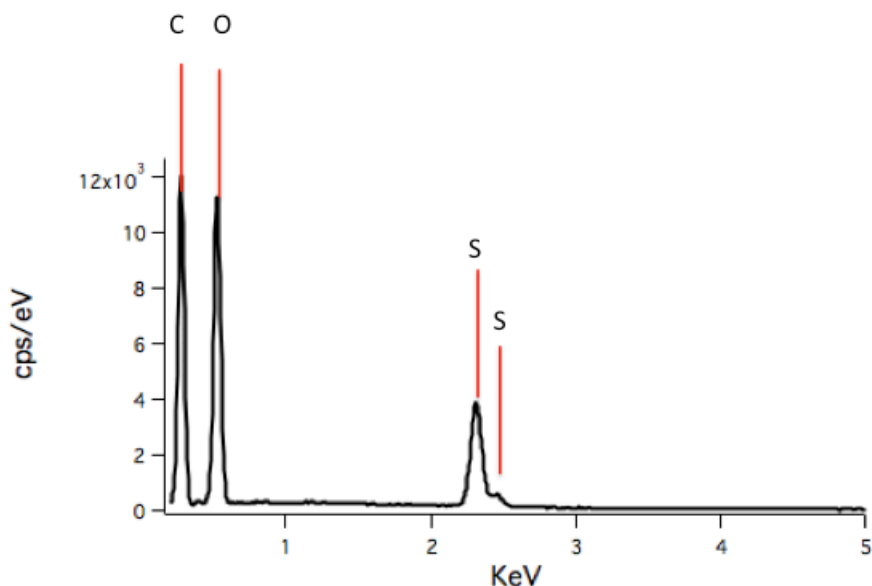


Figure S1. EDX of the membrane (PEGDMA:VS=10:2)

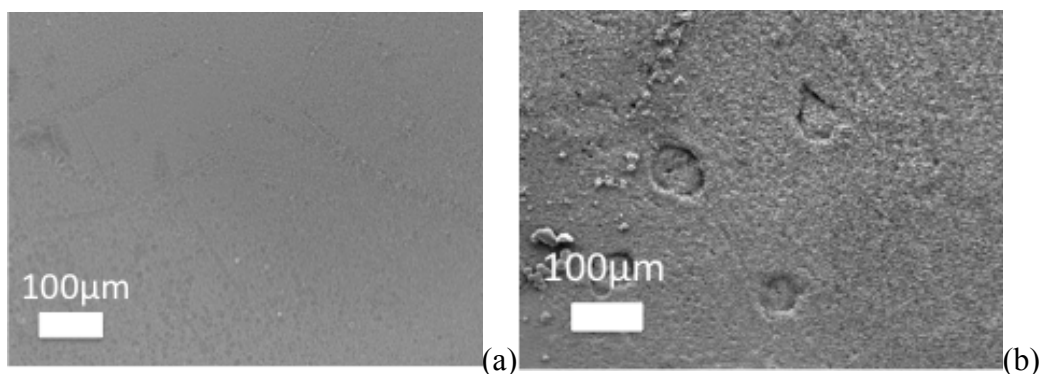


Figure S2. Zoom out SEM images of the membranes (a) PEGDMA membrane; (b) membrane with sulfonate groups.

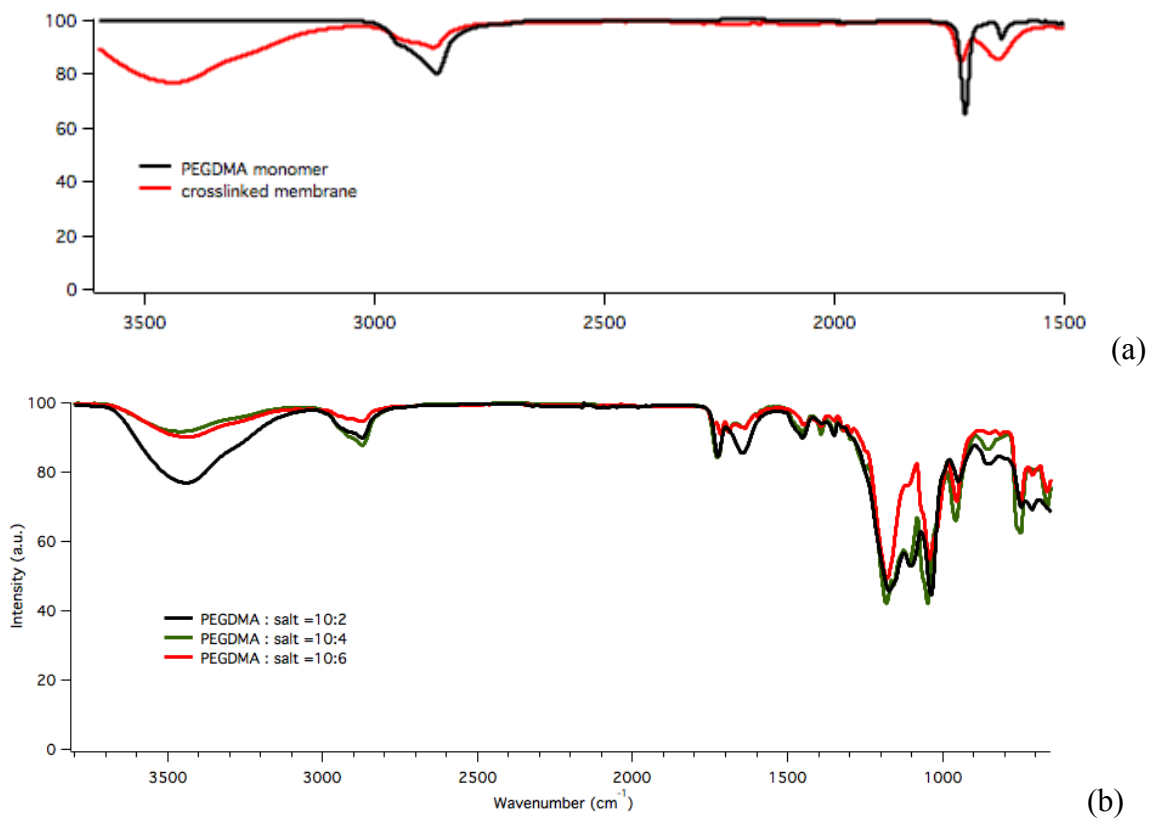
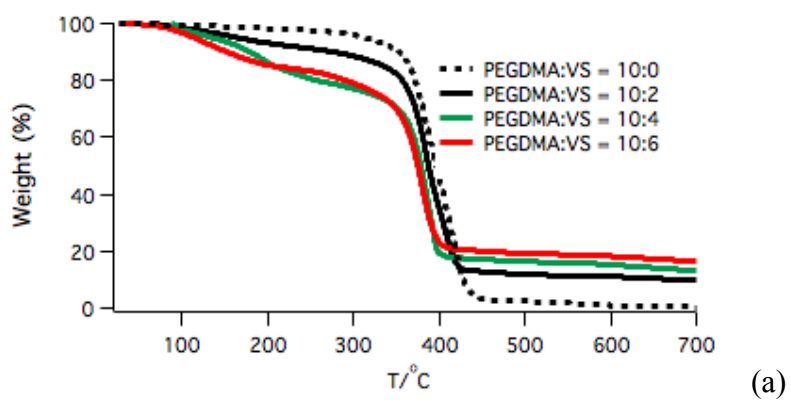


Figure S3. FTIR of the cross-linked membrane. (a) Zoom in FTIR of the PEGDMA monomer and the sulfonate containing cross-linked membrane. (b) FTIR of the cross-linked membrane with different content of sulfonate groups.



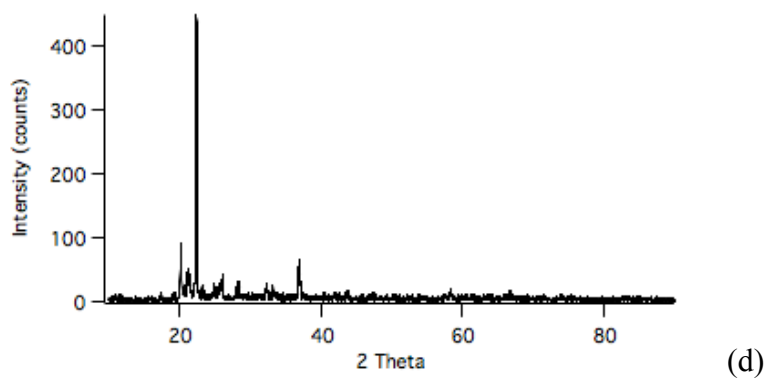
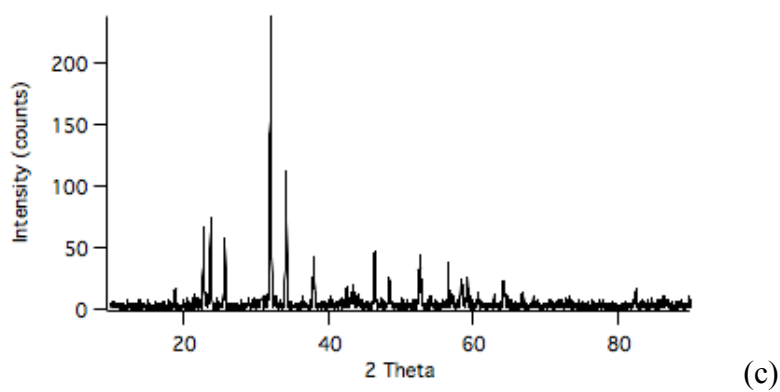
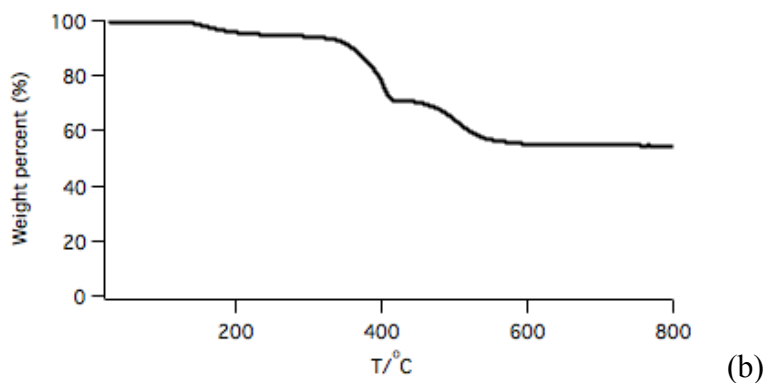


Figure S4. (a) TGA of cross-linked membrane with different content of sulfonate groups; (b) monomer salt VS. (c) XRD of the residue of (b), which shows  $\text{Na}_2\text{SO}_4$  peaks. (d) XRD of the residue of (a), which shows  $\text{Li}_2\text{SO}_4$  peaks.

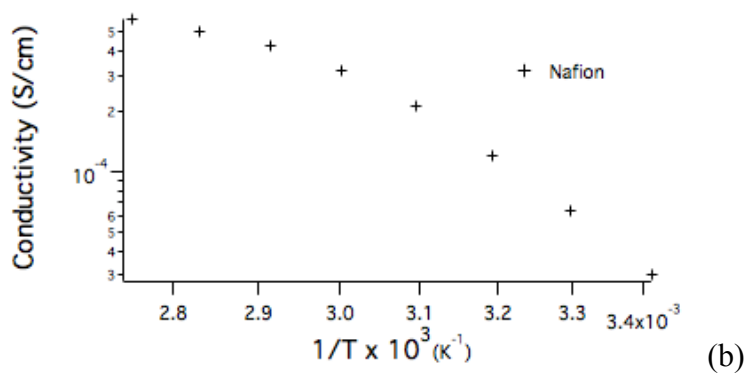
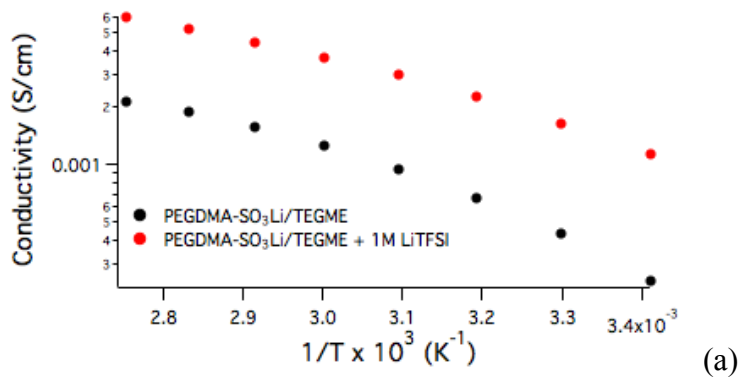


Figure S5. (a) Conductivity of the cross-linked membrane (PEGDMA:VS=10:6) soaked in blank DOL/DME electrolyte (black) and in LiTFSI containing electrolyte (red); (b) conductivity of Nafion soaked in the same electrolyte.

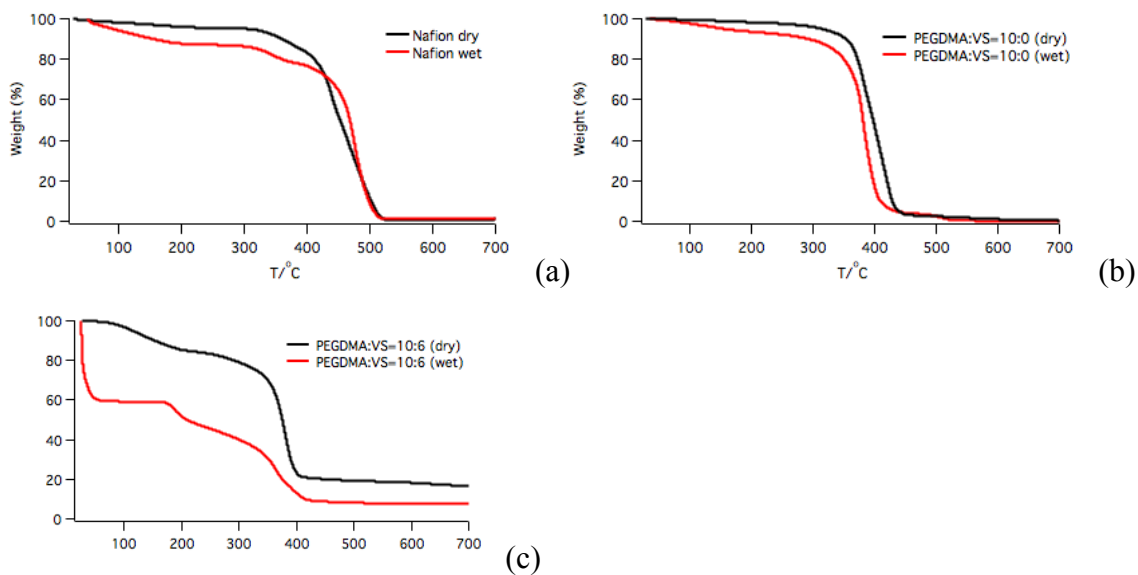
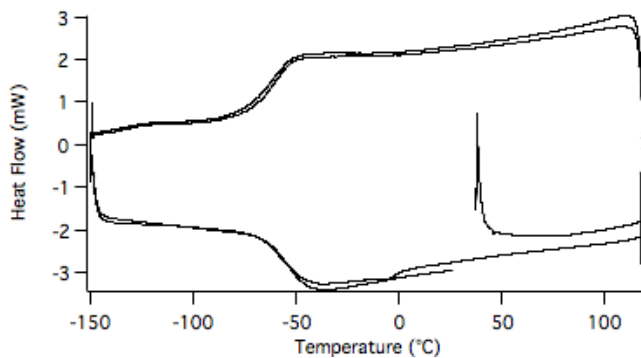
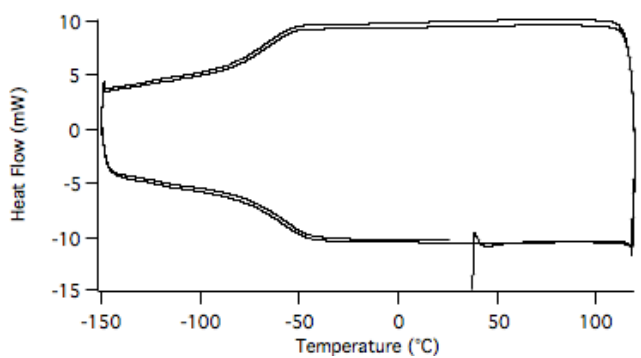




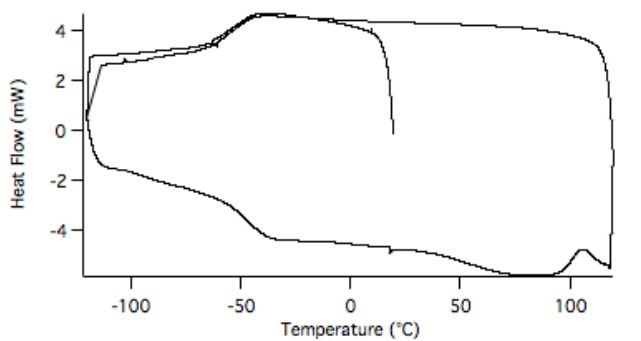
Figure S6. TGA of membrane soaked in blank DOL/DME electrolyte (a) Nafion (b) PEGDMA:VS = 10 : 0 (c) PEGDMA:VS = 10 : 4



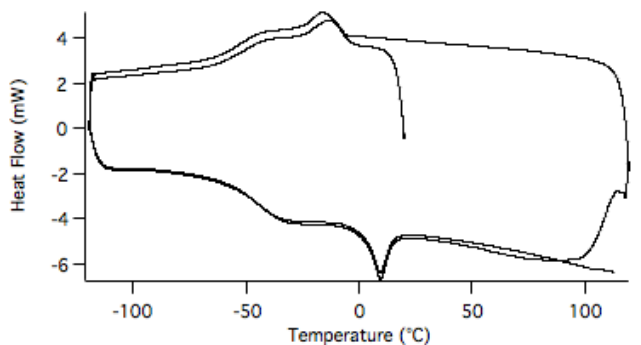
PEGMDA:VS=10:0



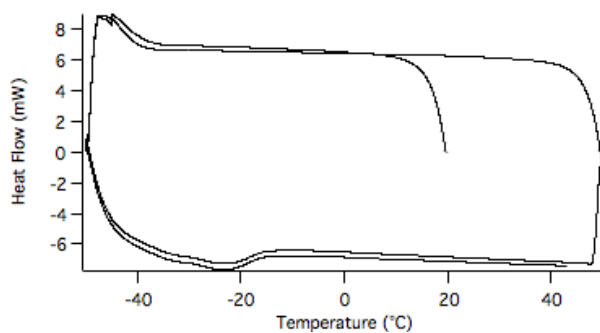
PEGMDA:VS=10:2



PEGMDA:VS=10:4



PEGMDA:VS=10:6



PEGMDA:VS=10:6 with solvent

Figure S7. DSC of the membranes. A heating and cooling rate of 10°C/min is used.

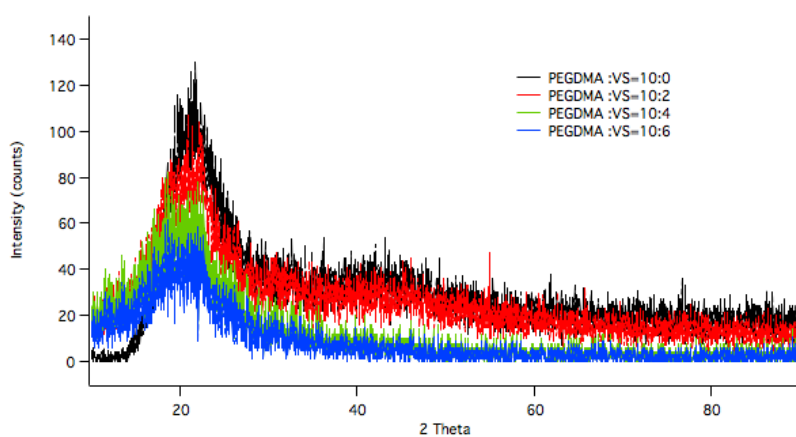


Figure S8. XRD of the membranes at room temperature.

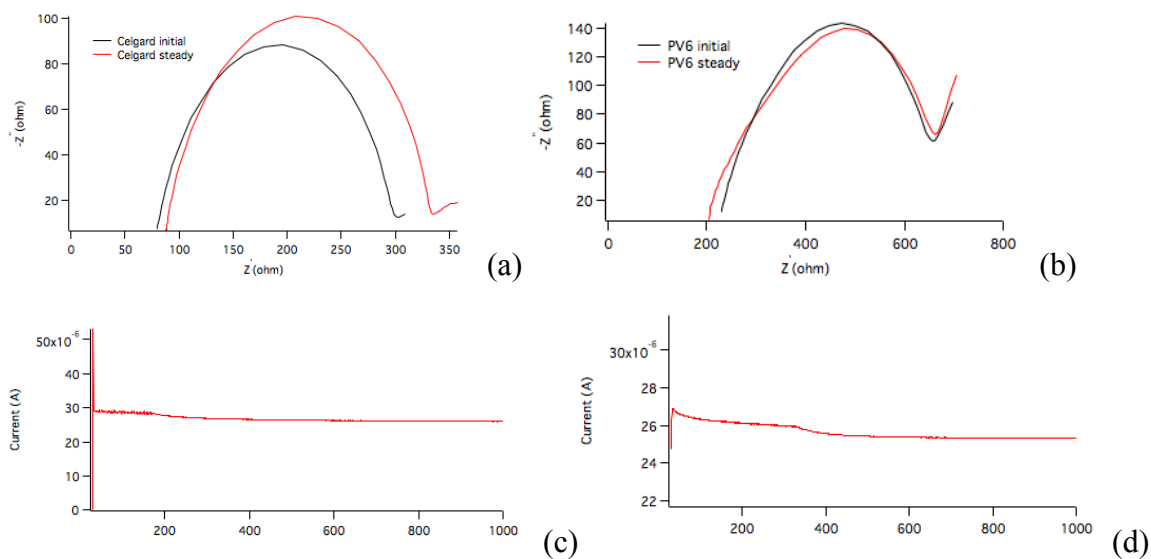


Figure S9. Transference number measurement. Impedance before and after polarization of (a) Celgard membrane and (b) PV6. Polarization profile of (c) Celgard membrane and (d) PV6.

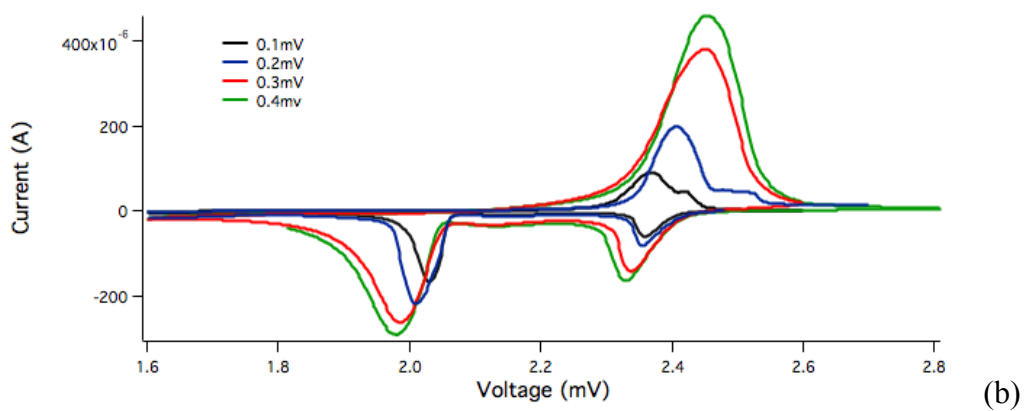
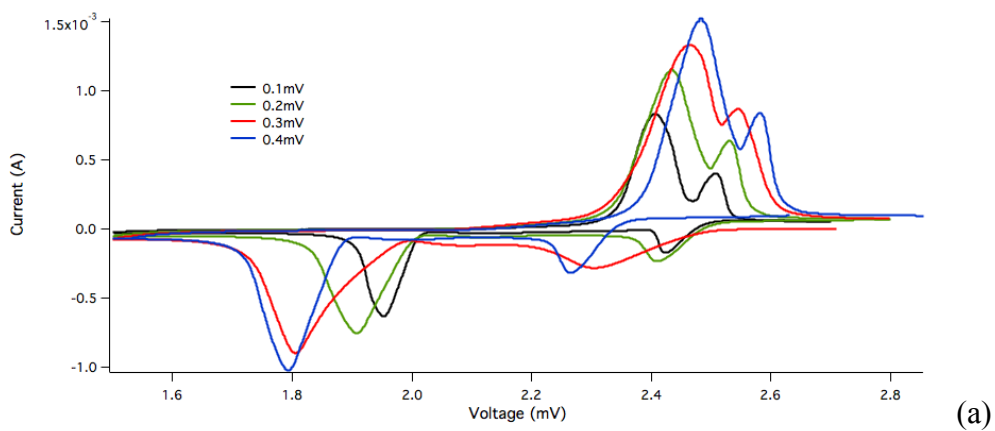


Figure S10. CV of the Li-S cells at different scan rate with (a) Celgard; (b) PV6.

$D_{Li}$ ( $cm^2/s$ )	Celgard	PV6
1 <sup>st</sup> reduction peak ( $>2.2V$ )	1.71874E-08	1.70542E-08
2 <sup>nd</sup> reduction peak ( $<2.0V$ )	2.28979E-08	1.22987E-08
Oxidation peak	3.36873E-07	2.17528E-07

Table S1. Diffusion coefficient of lithium ion of the redox peaks in Li-S cells.

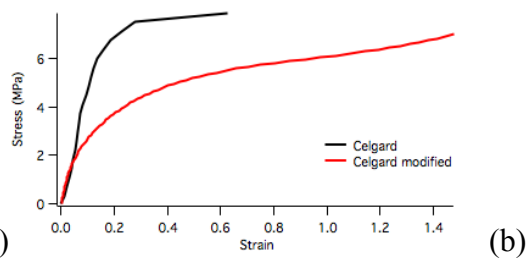
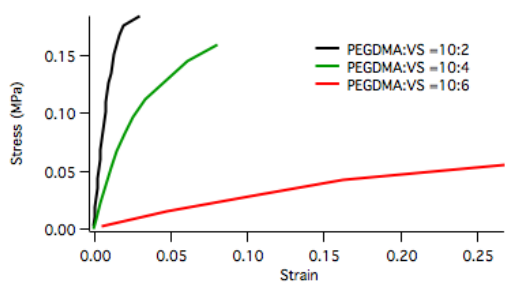


Figure S11. Mechanical properties of the membrane. (a) membranes with different sulfonate content; (b) sandwich-typed membrane.

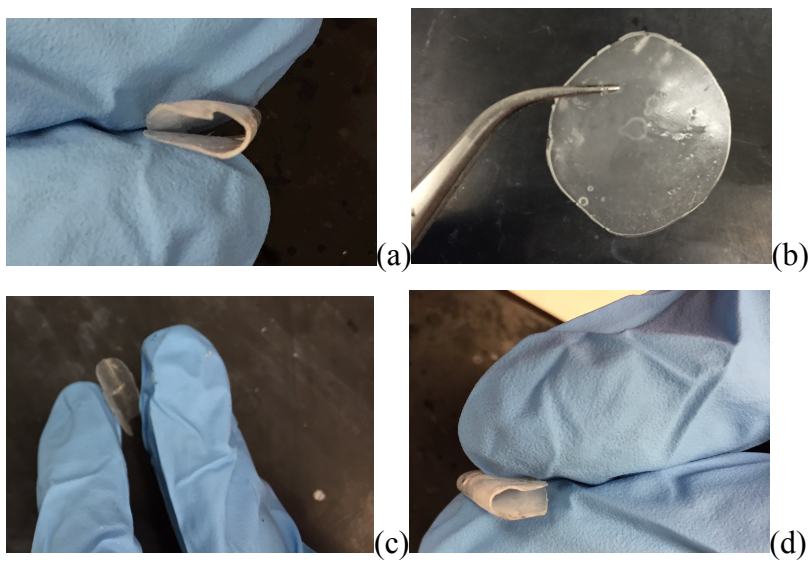


Figure S12. Images of (a) PV6; (b)~(d) the PV6-Celgard-PV6 sandwich membrane.