

Supporting Information for

**A simple approach for superior performance of lithium/sulfur
batteries modified with gel polymer electrolyte**

Sheng S. Zhang*, Dat T. Tran

Electrochemistry Branch, RDRL-SED-C, Sensors and Electron Devices Directorate,
U.S. Army Research Laboratory, Adelphi, MD 20783-1197, USA

Supplemental Figures and notes

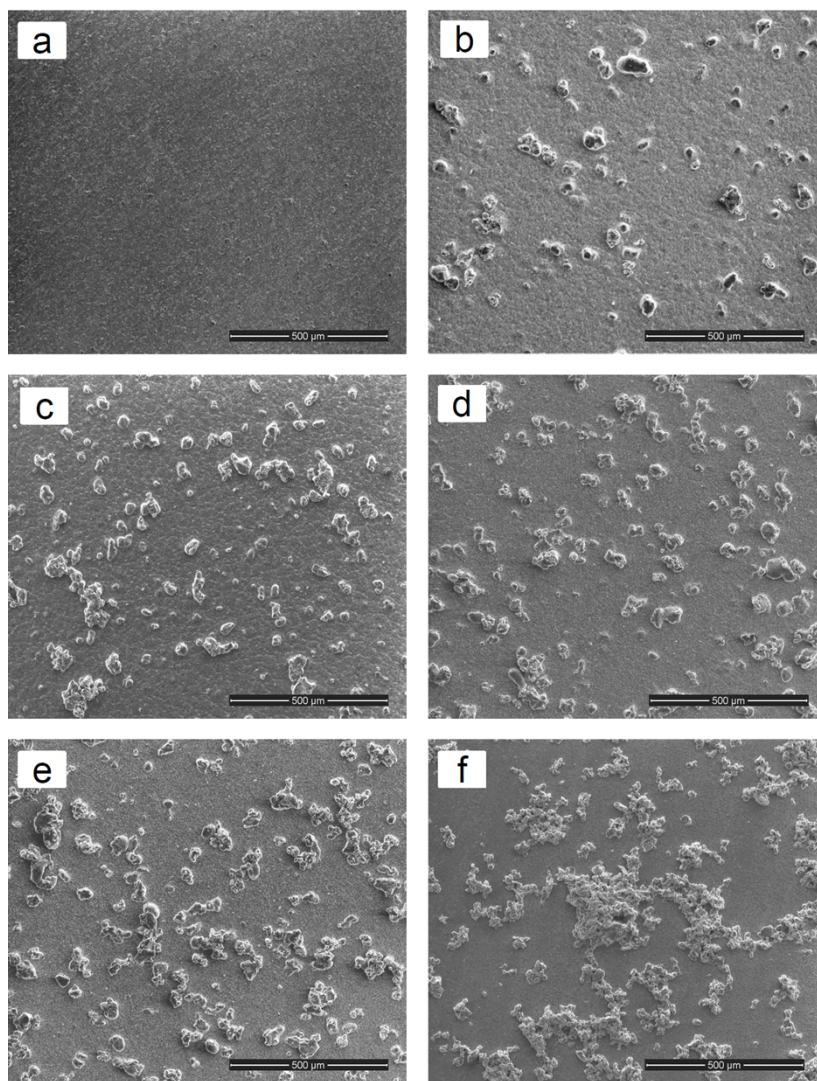


Figure S1. SEM image of (100-x)PEO-xS coated separators. (a) x=0, (b) x=20, (c) x=30, (d) x=40, (e) x=50, and (f) x=60. All scale bars are 500 μm .

* Corresponding author: Tel: +1-301-394-0981; Fax: +1-301 394-0273.

E-mail address: shengshui.zhang.civ@mail.mil or shengshui@gmail.com (S.S. Zhang)

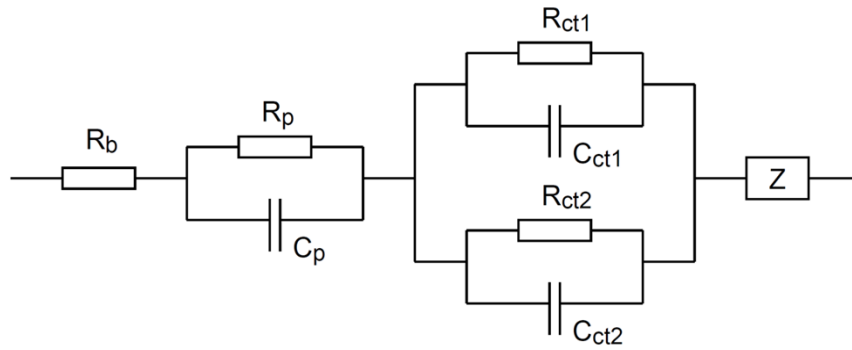


Figure S2. Equivalent circuit used for fitting of EIS.

The EIS was fitted using an equivalent circuit shown in Figure S2, in which R_b is the overall resistance of electrolyte-wetted separator and cell hardware, R_p and C_p are the resistance and capacitance of passivation layer, or called solid electrolyte interface (SEI), on the surface of lithium, R_{ct1}/C_{ct1} and R_{ct2}/C_{ct2} are the resistance and capacitance of charge-transfer process for lithium and sulfur, respectively, on the electrolyte-lithium interface, and Z is Warburg impedance reflecting the semi-infinite linear diffusion of Li^+ ions. The R_{ct1}/C_{ct1} and R_{ct2}/C_{ct2} correspond to the following two electrochemical processes, respectively [1].



For Li/P-separator/Li cell in the absence of sulfur, R_{ct2}/C_{ct2} are taken as the infinity. In this case the EIS consists of two overlapped semicircles (see Fig. 3a in article). In Li/SC-separator/Li cell, eq. 1 and eq. 2 undergo simultaneously and contribute to impedance. Since the R_{ct1}/C_{ct1} and R_{ct2}/C_{ct2} are in the similar response time range, their semicircles are merged into a semicircle that is further overlapped with the R_p/C_p semicircle. As a result, the Li/SC-separator/Li cell shows only a broad semicircle (see Fig. 3b in article). The R_p of Li/SC-separator/Li cell was fitted using the same frequency range as obtained from the Li/P-separator/Li cell.

Reference

- 1 S.S. Zhang, *Electrochim. Acta*, 2012, **70**, 344.