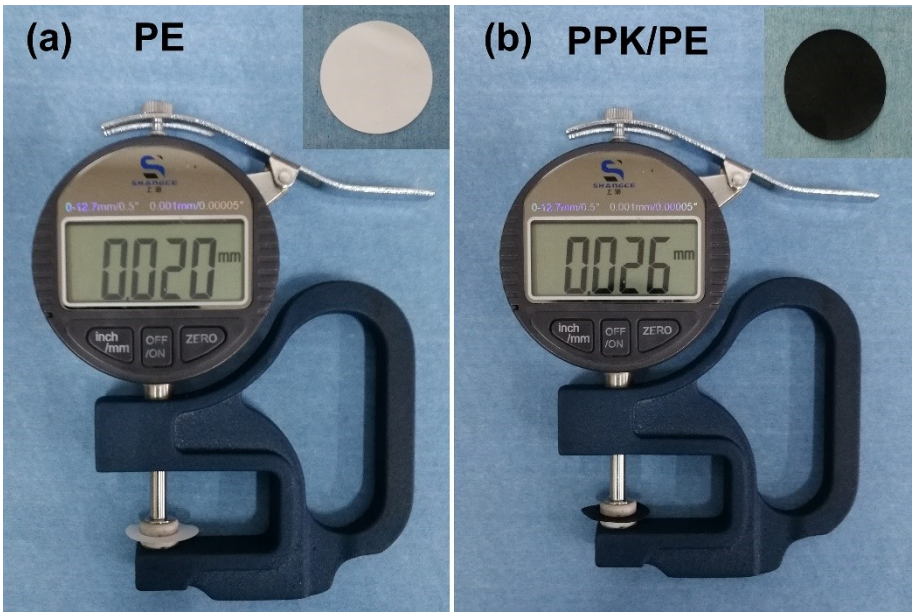


Figure S1 The thicknesses of PE and PPK separator measured by dial thickness gauge

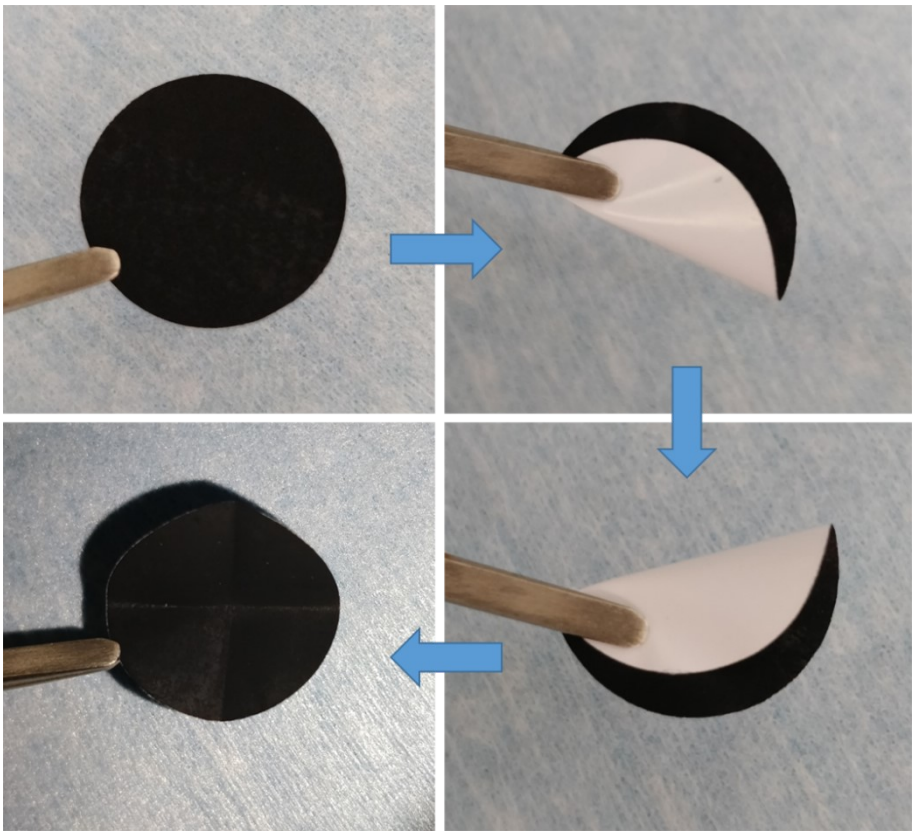


Figure S2 The bending strength test for PPK separator

Figure S3 The measurements of ohmic resistances for PE and PPK separator by using the digital multimeter

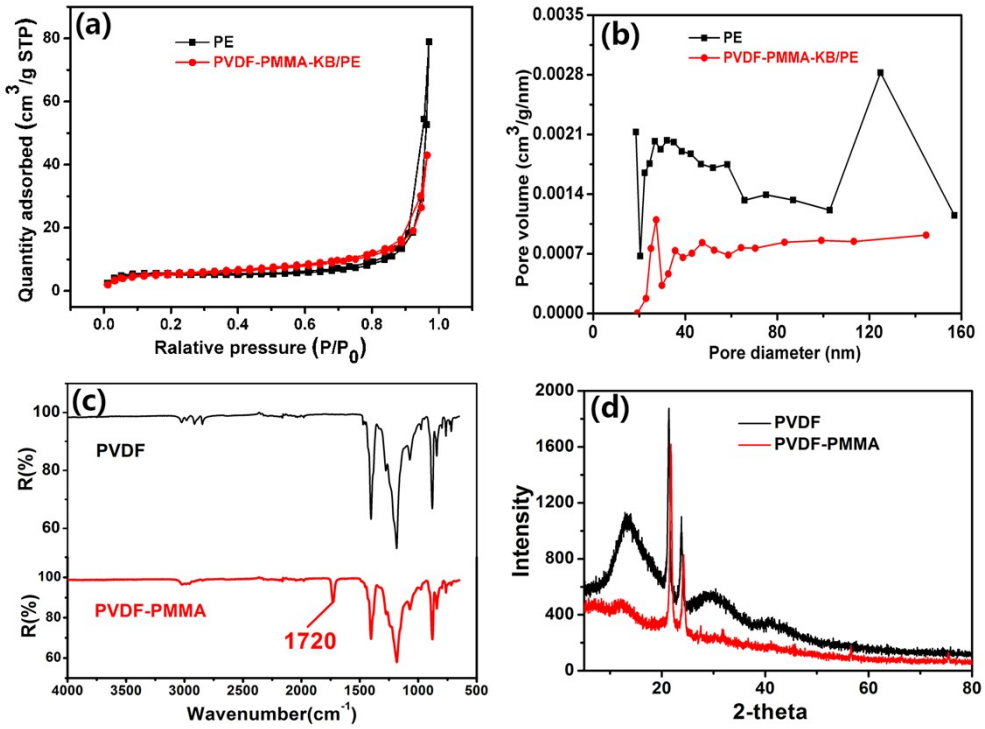


Figure S4 (a) Nitrogen adsorption-desorption and (b) pore size distribution curves of PE and PPK modified separator, (c) FTIR spectra and (d) XRD patterns of PVDF and PVDF-PMMA

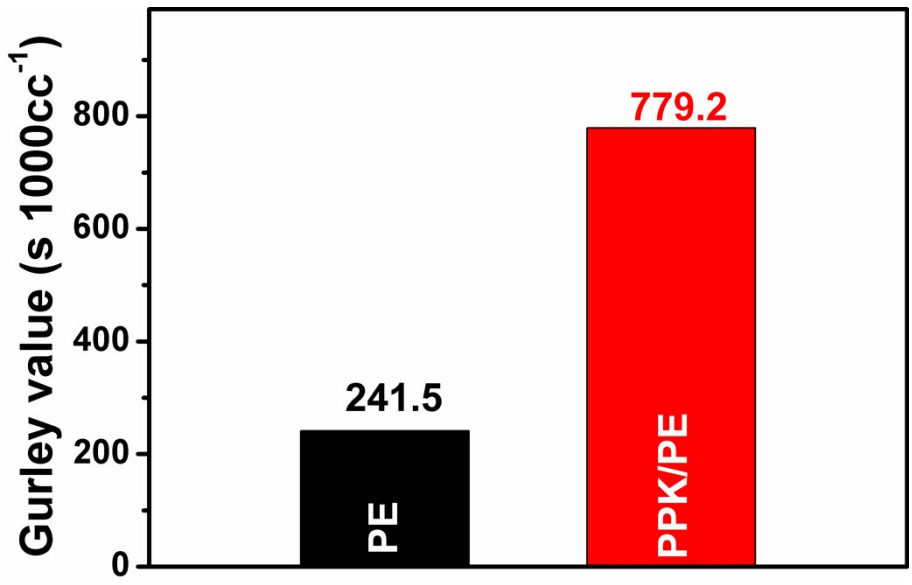


Figure S5 Gurley values of PE and PPK separator

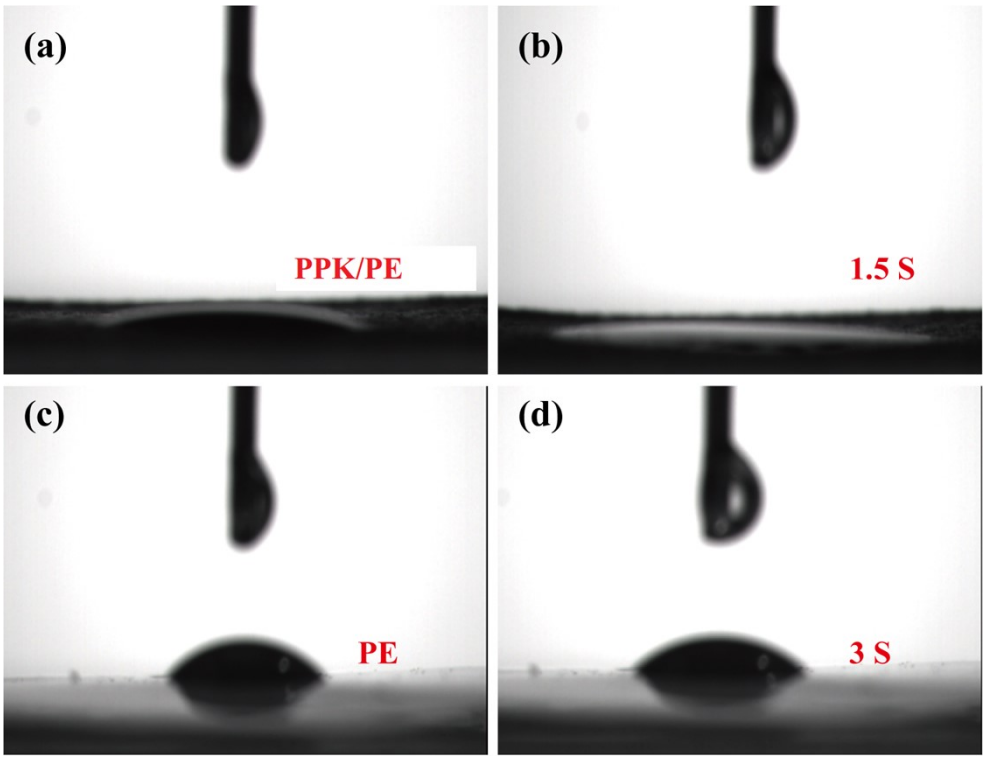


Figure S6 contact angle test of PE and PPK/PE separator.

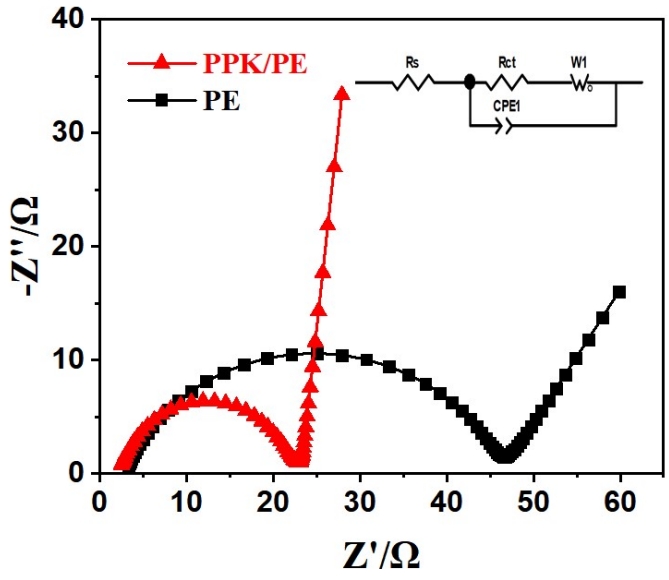
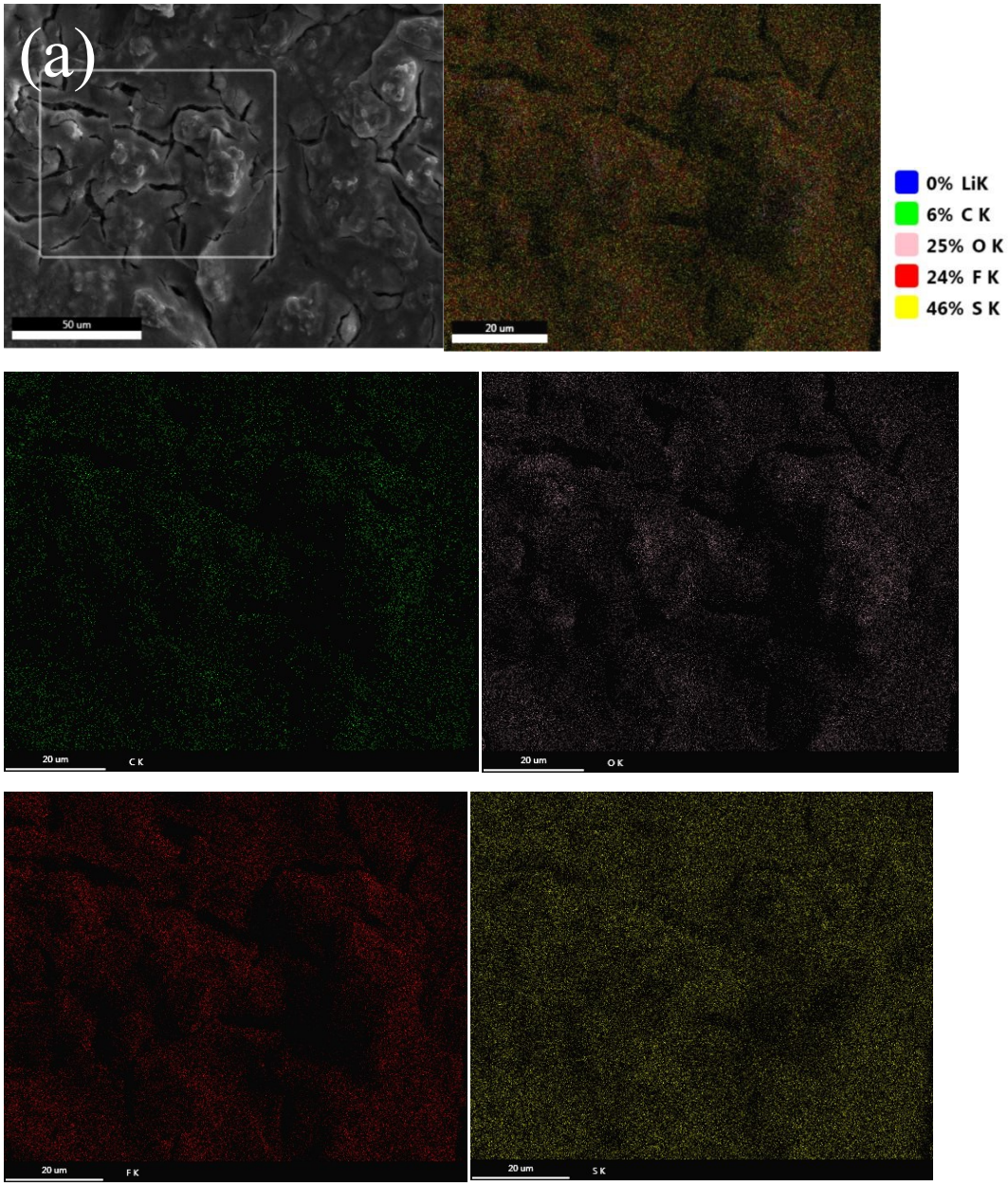
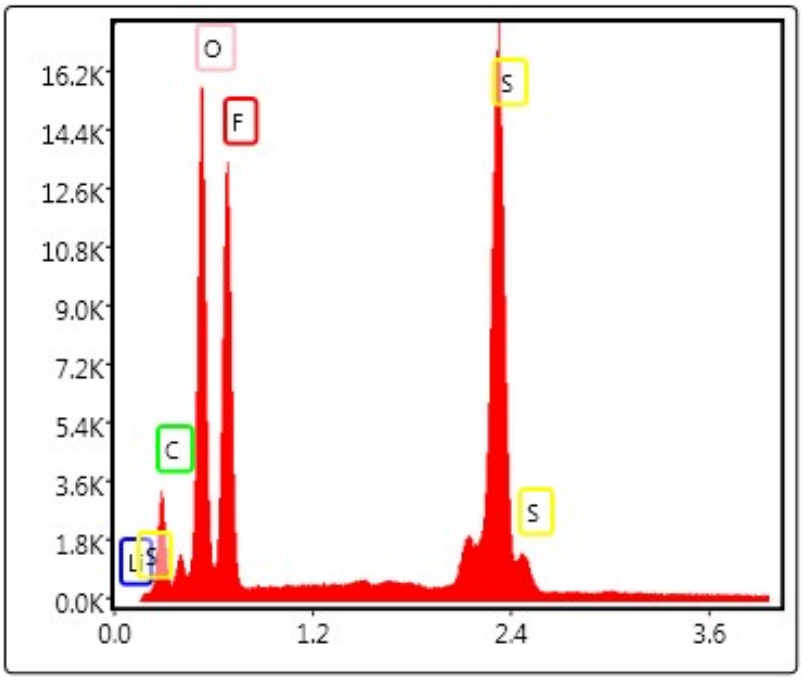
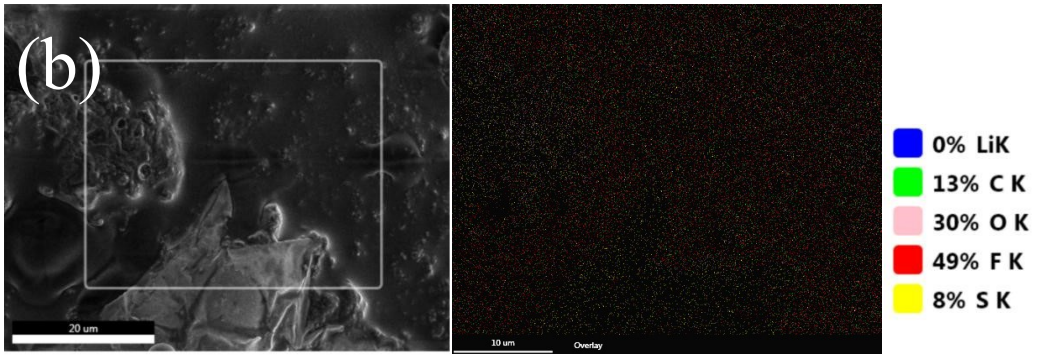
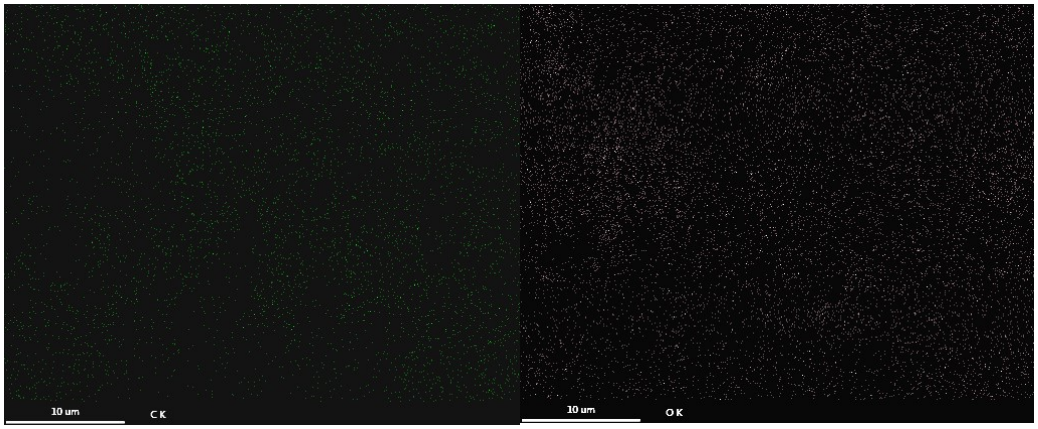


Figure S7 EIS curves of PPK/PE and PE separator after 100 cycles.


(a)
50 um
20 um
0% LiK
6% C K
25% O K
24% F K
46% S K
20 um
C K
20 um
O K
20 um
F K
20 um
S K


O
F
C
S
S
Li
S
16.2K
14.4K
12.6K
10.8K
9.0K
7.2K
5.4K
3.6K
1.8K
0.0K
0.0
1.2
2.4
3.6


(b)
20 um
10 um
Overlay
0% LiK
13% C K
30% O K
49% F K
8% S K


10 um
C K
10 um
O K

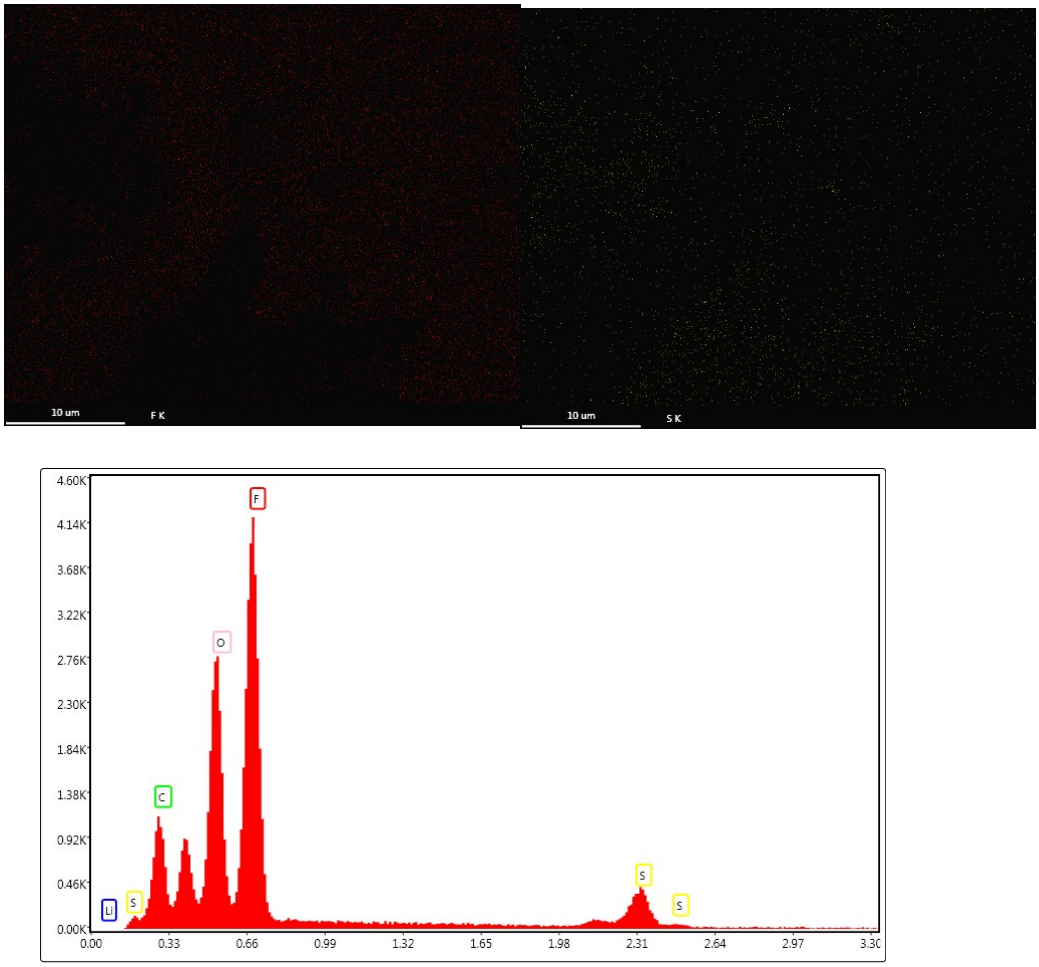
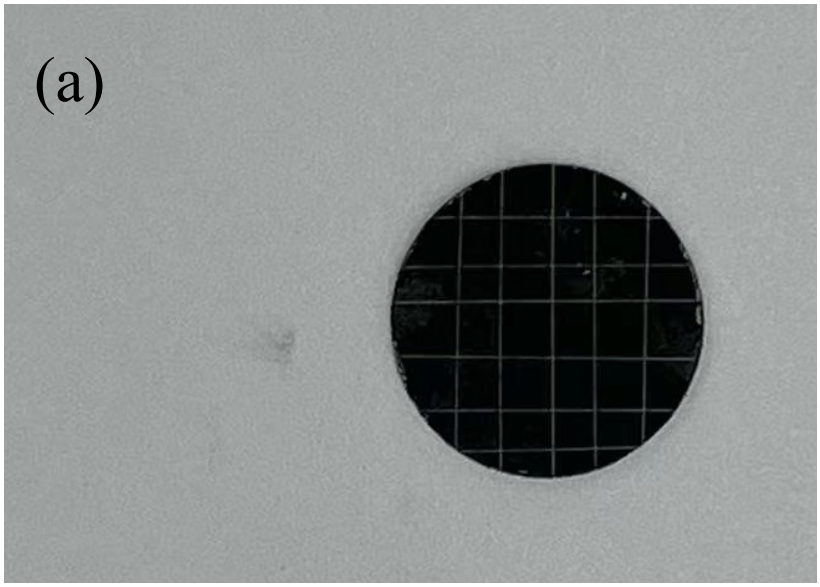


Figure S8 SEM and EDS analysis of Li anode of (a) PE and (b) PPK/PE separator samples after cycle.



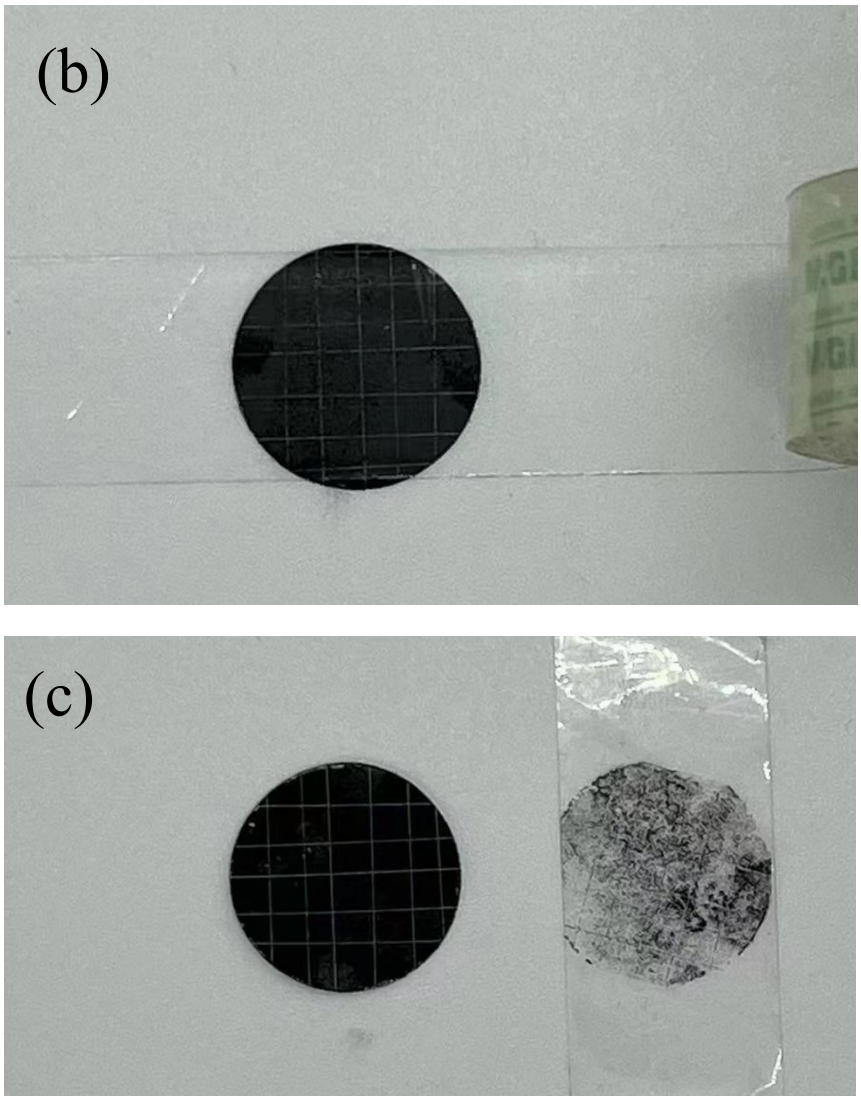


Figure S9. (a) coated separator adhered on a board, (b) scotch tape was stick on the surface of the coated layer, (c) the surface picture of the coated layer after the scotch tape was peeled of.