Supporting Information

Enlarged interlayer of separator coating enabling high-performance lithium-sulfur batteries

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1. Supplementary Experimental Sections

Visualized adsorption test: The Li_2S_6 solution (0.2 M) was prepared by stoichiometrically mixing Li_2S and sulfur with a molar ratio of 1:5 in a mixture of DME and DOL (1:1 by volume) and magnetic stirred for 24 h in Ar atmosphere. 1 mL Li_2S_6 solution was sealed in the little bottle using KVO and V_2O_5 modified separator (PE separator as blank counterpart). This little bottle was closed with an open cap to get contact with the outer big bottle which comprised 3 mL DME solution. The Li_2S_6 solution may diffuse through separator owing to the concentration gradient and the trapping ability can be evaluated by the color change in the big bottle.

Li_2S_6 symmetric cell assembly: 80 wt% active materials (KVO and V_2O_5) mixed with 10 wt% PVDF and 10 wt% super P were homogenized in NMP into a consistent slurry followed applied on Al foil. CR2025 cells were assembled by using two identical electrodes as the working and the counter electrode. The electrolyte was 20 μL of 1 M LiTFSI and 0.2 M Li_2S_6 electrolyte dissolved in a 1:1 (v/v) DOL/DME mixture, PE as separator. Cyclic voltammetry (CV) was measured at a scan rate of 10 mV s^{-1} between −1.0 and 1.0 V.

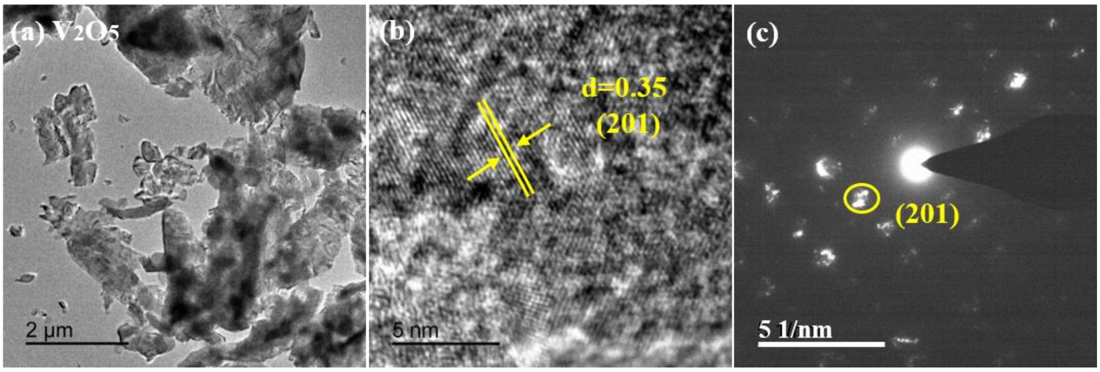

Figure S1. (a) TEM image, (b) high-resolution TEM image and (c) SAED patterns of V_2O_5.

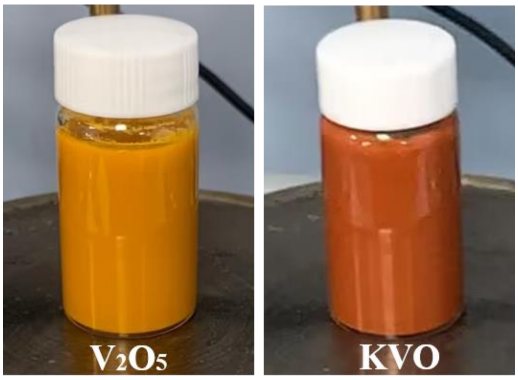

Figure S2. digital photograph of V_2O_5 (left) and KVO (right) suspension.

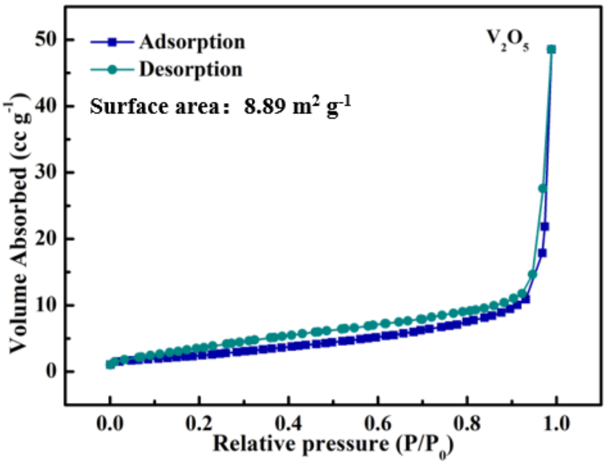

Figure S3. N_2 adsorption-desorption isotherms of V_2O_5.

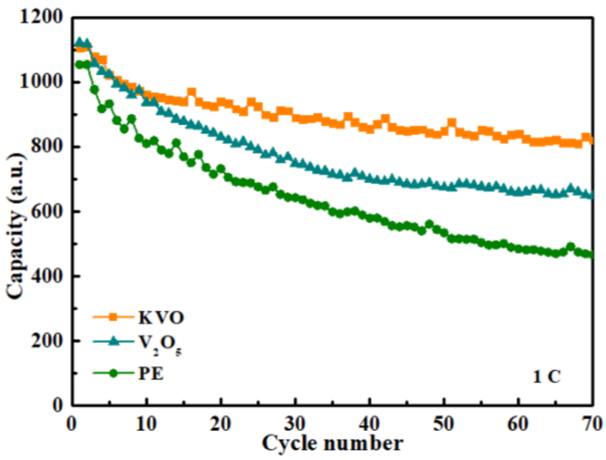

Figure S4. Cycling performance at 1C rate of batteries with pristine PE, V_2O_5 and KVO separators.

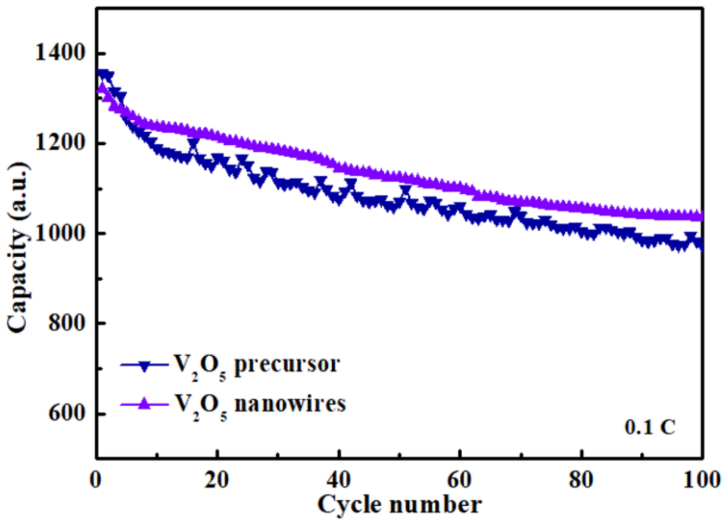

Figure 5. The electrochemical performance of lithium-sulfur batteries based on V_2O_5-precusor and V_2O_5 nanowire coated separator at 0.1C.

Table S2. The electrochemical performance comparisons of modified separator for Li-S batteries

Coating materials	Initial capacity (mAh g^{-1})	Cycle behavior (retention rate)	Decay (% per cycle)	refs
rGO@MoS_2	877	1 C 42% after 500 cycles	0.116 %	[1]
TiO_2-C-PP	1227	0.1 C 71.9% after 180 cycles	0.156 %	[2]
MWCNTs/CeO_2	898.3	0.2 C 58% after 300 cycles	0.14 %	[2]
CeO_2/RGO	1136	0.1 C 78% after 100 cycles	0.22 %	[3]
TiO_2@CBBC	1060	2 C 69.5 % after 250 cycles	0.122%	[4]
EUV/graphene	1164	0.2 C 55% after 300 cycles	0.15%	[5]
NC/TiN NWs@PP	1081	0.2 C 61% after 150 cycles	0.26%	[6]
VO_2@CNTs	730	0.5 C 89% after 100 cycles	0.11%	[7]

CoFe@NC	1200	0.2 C 84.8% after 100 cycles	0.152%	[8]
MoS_2	1471 (0.1 C)	0.5 C 50.2% after 600 cycles	0.83%	[9]
KVO	1362	0.2 C 76.6% after 320 cycles	0.073%	this work

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