Supporting Information

Multifunctional Vanadium Nitride-Modified Separator for High-Performance Lithium–Sulfur Batteries

Sen Liu, Yang Liu *, Xu Zhang, Maoqiang Shen, Xuesen Liu, Xinyue Gao, Linrui Hou and Changzhou Yuan *

School of Materials Science & Engineering, University of Jinan, Jinan 250022, China; liusen@stu.ujn.edu.cn (S.L.); zhangxu@stu.ujn.edu.cn (X.Z.); shenmq@stu.ujn.edu.cn (M.S.); liuxs@stu.ujn.edu.cn (X.L.); gaoxinyue@stu.ujn.edu.cn (X.G.); mse_houlr@ujn.edu.cn (L.H.)

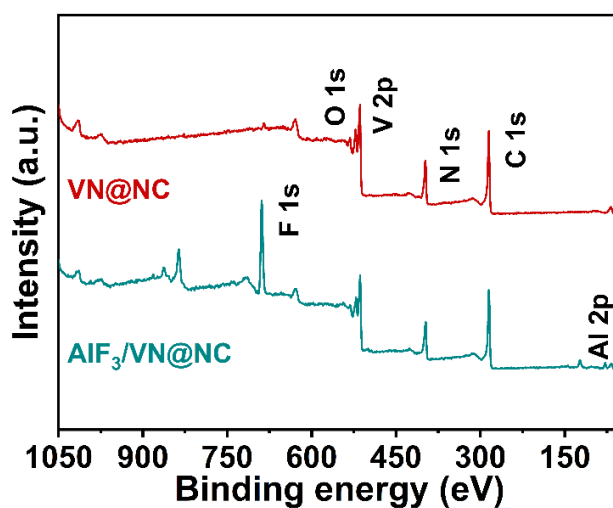* Correspondence: mse_liuy@ujn.edu.cn (Y.L.); ayuancz@163.com or mse_yuancz@ujn.edu.cn (C.Y.)
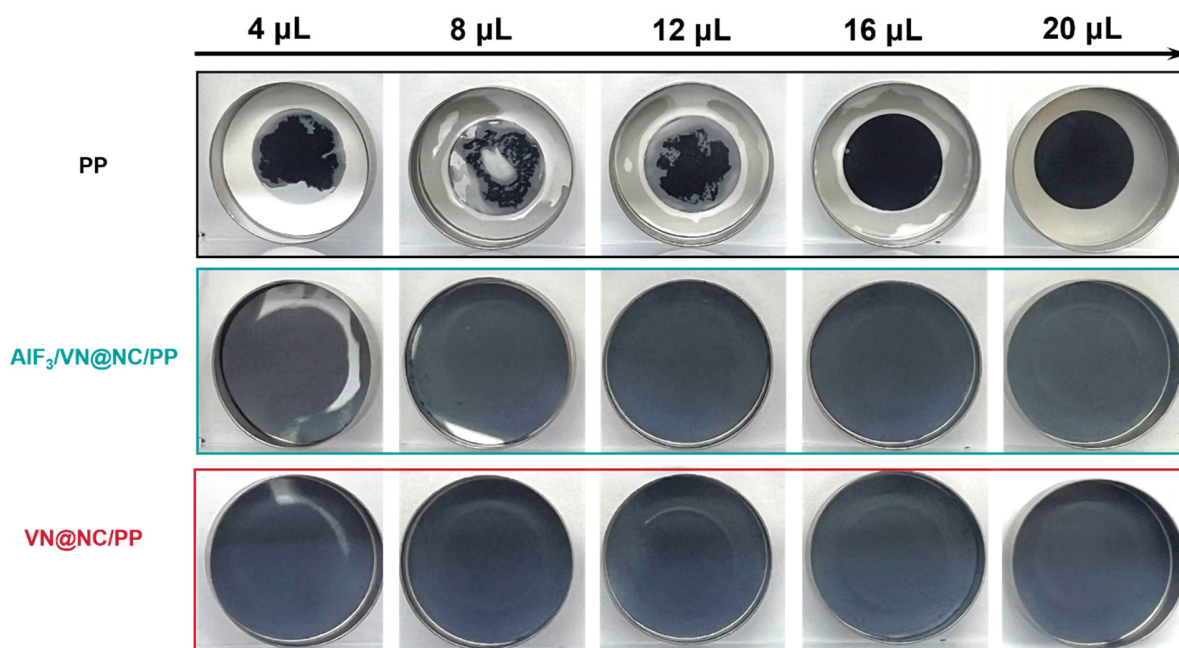
Figure S1. XPS survey spectrum of VN@NC and AlF$_3$/VN@NC.

Figure S2. Digital photographs of the amount of electrolyte required to wet the VN@NC/PP, AlF3/VN@NC/PP, and PP separators
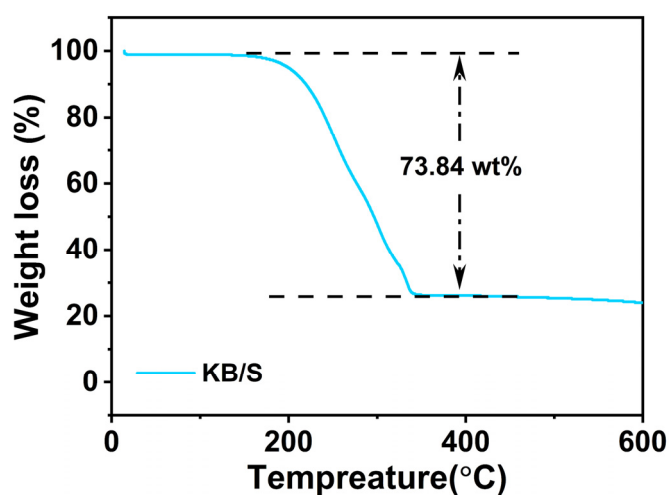

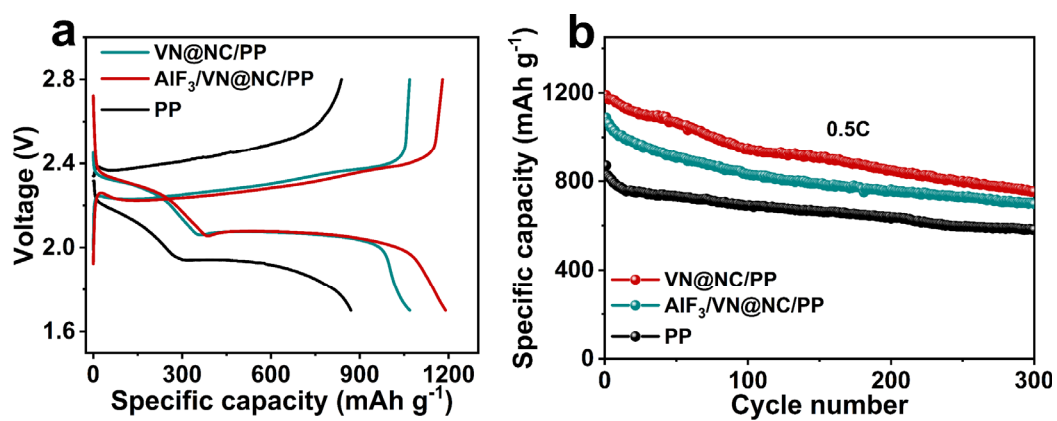**Figure S3.** TG diagram of KB/S for checking the sulfur loading.

Figure S4. **(a)** Charge-discharge curves of the first cycle and **(b)** cycling stability for the Li-S batteries with different separators at 0.5 C.
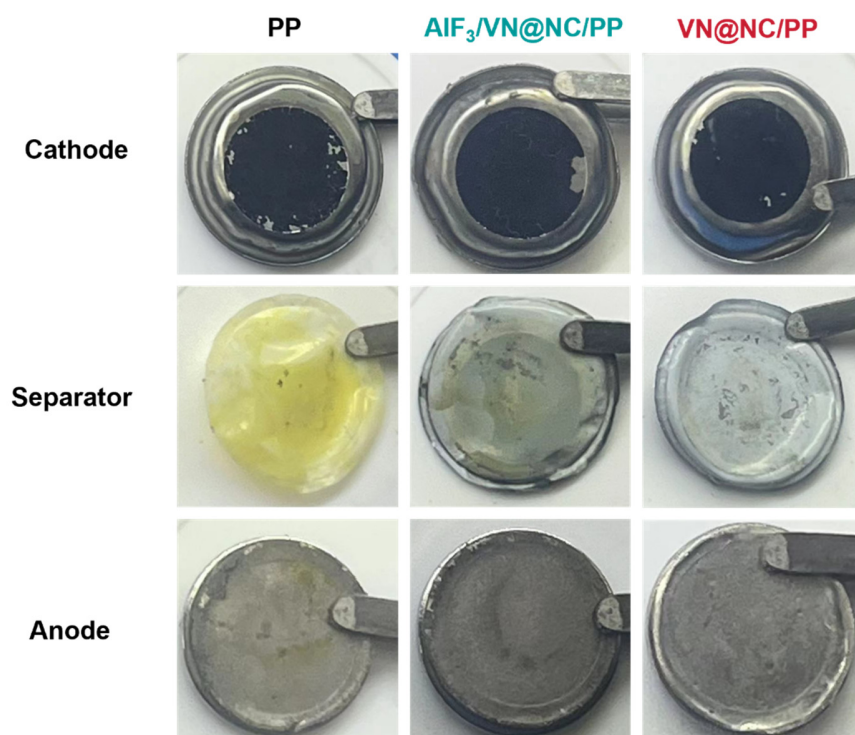
Figure S5. Digital images of the cathode, separators, and anode of lithium-sulfur batteries with VN@NC/PP, AlF$_3$/VN@NC/PP, and PP separator after deep cycling.

Table S1. Comparison of key performance parameters of different diaphragm modification materials for lithium-sulfur batteries.

separator	sulfur-loading (mg cm^{-2})	Initial capacity (mA h g^{-1})	Life (Cycling number)	current density (C)	decay/cycle	ref.
VN@NC	~1.0	1052.4	400	1	0.085%	this work
	~5.41	503.5	100	1	0.083%	this work
NSPCF@CoS$_2$@C-150	-	846.1	100	0.5	0.21%	[74]
	3.0	668.5	100	0.5	0.25%	
Ta$_4$C$_3$-Ta$_2$O$_5$	~0.9	801.9	500	1	0.086%	[75]
ZIF-67/SA-PAN	1	801.8	500	1	0.089%	[76]
	5.45	-	100	0.1	0.098%	
TpPa-SO$_3$H/Celgard	1	887	100	0.2	0.42%	[77]
	5.4	788	100	0.2	0.16%	
Co$_3$O$_4$@GC/N-CNT NF-coated separator	2.0	1187	250	0.1	0.16%	[78]
Al-CPP/Celgard	~1	935.7	500	1	0.12%	[79]
N-C@TiO$_2$/HNC-coated separator	1.64	1373	500	0.1	0.11%	[80]
CNT CoN-V$_N$	2.5	851.6	250	2	0.09 %	[81]