Appendix. Supplementary materials

Multifunctional integrated VN/V$_2$O$_5$ heterostructure sulfur hosts for advanced lithium-sulfur batteries

Bo-Tian Liu$^{a,b}$$^{#}$, Huan Li$^{c}$$^{#}$, Chenglong Shi$^{a}$, Junlong Sun$^{a}$, Shunhua Xiao$^{a}$, Youyong Pang$^{a}$, Jianwen Yang$^{a}$, Yanwei Li$^{*}$

$^{a}$Guangxi Key Laboratory of Electrochemical and Magneto-chemical Functional Materials, College of Chemistry and Biological Engineering, Guilin University of Technology, Guilin 541004, China.

$^{b}$Guangdong Institute of Semiconductor Industrial Technology, Guangdong Academy of Science, Guangzhou 510650, China.

$^{c}$School of Materials Science and Engineering, Guilin University of Electronic Technology, Guilin 541004, China.

$^{#}$Authors contributed equally

$^{*}$Corresponding author

Email: btliu2018@glut.edu.cn (B.-T Liu); lywhit@126.com (Y. Li)
Figure S1. (a-e) HAADF-TEM image and corresponding EELS elemental mapping of \( \text{VN}_2\text{O}_5 \) sample, (f) SAED pattern and corresponding \( \text{V}_2\text{O}_5 \) (211), VN (200) and VN (220) crystal plane of \( \text{VN}_2\text{O}_5 \) sample.
Figure S2. Digital photograph showing the V$_2$O$_5$ dissolution test by 5% H$_2$O$_2$ treatment.

Form the dissolution test result, the actual VN content is ~23.4 wt%.
Figure S3. Cyclic performance of VN/V$_2$O$_5$ and V$_2$O$_5$ cathodes without sulfur loading.
Figure S4. EIS curves of (a) V$_2$O$_5$-S and (b) VN/V$_2$O$_5$-S cathodes before/after cycling.

Figure S5. TGA curve of VN/V$_2$O$_5$-S in N$_2$ atmosphere heated from room temperature to 500 °C with the ramping rate of 10 °C min$^{-1}$.
Figure S6. GDC profiles of the high sulfur loading VN/V$_2$O$_5$-S cathode at various rates.

Figure S7. (a) Cross-sectional SEM image of VN/V$_2$O$_5$-S cathode, and (b) corresponding element mapping images.