Supporting information

Conductive Framework Embedded with Cobalt doped Vanadium Nitride as Efficient Polysulfide Adsorber and Convertor for Advanced Lithium-sulfur Batteries

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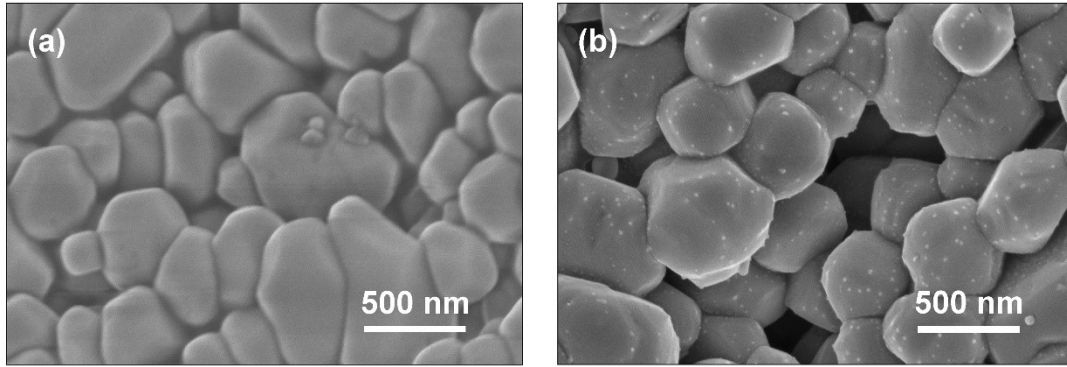[#]Yang Lu and Menglong Zhao contributed equally to this work.

Figure S1. (a) SEM images of the NaCl@Co-V precursor after freeze-drying. (b) SEM images of Co-VN/NC before removal of the NaCl template.
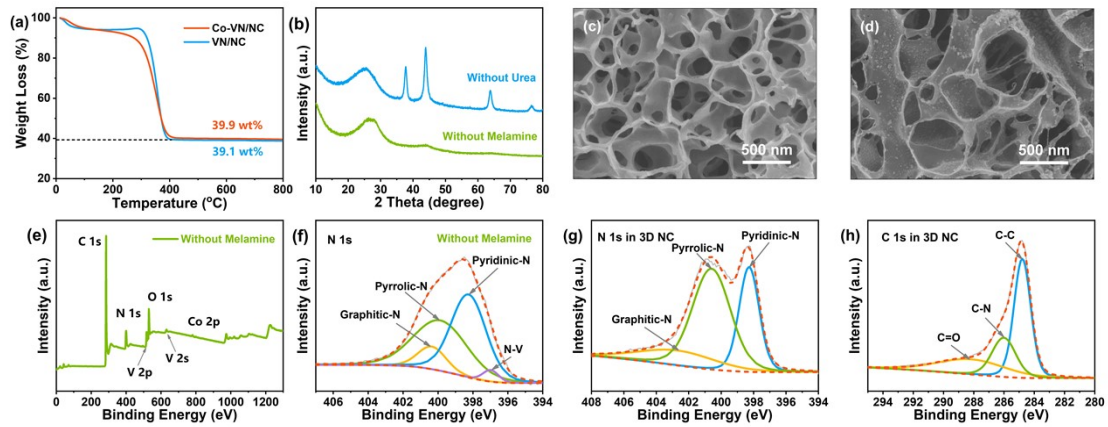
Figure S2. (a) the thermogravimetric analysis of Co-VN/NC in Air. (b) XRD pattern of the samples in control experiments. (c) SEM images of the sample were annealed without adding melamine. (d) SEM images of Co-VN/NC without adding urea. (e, f) The full XPS survey spectrum and high-resolution spectra of the sample without melamine, respectively. (g, h) High-resolution XPS spectra of N 1s and C 1s in 3D NC, respectively.
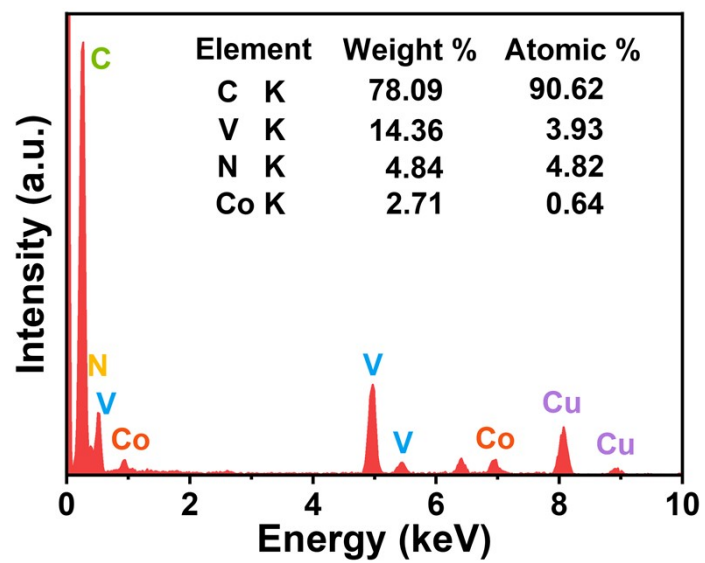
Element		Weight %	Atomic %
C	K	78.09	90.62
V	K	14.36	3.93
N	K	4.84	4.82
Co	K	2.71	0.64

Figure S3. The EDX spectrum of Co-VN/NC, where the Cu signals come from the copper mesh.
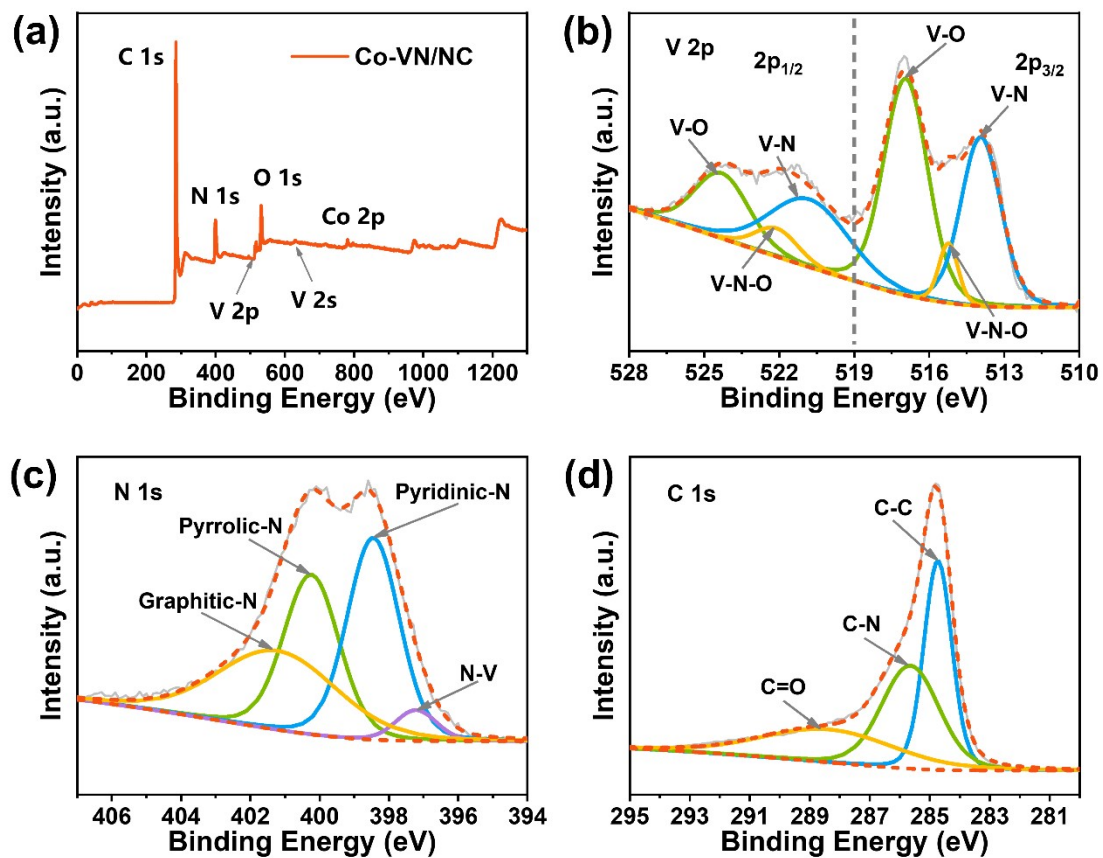
Figure S4. (a) XPS survey spectrum of Co-VN/NC. (b-d) High-resolution XPS spectra of V 2p, N 1s and C 1s in Co-VN/NC, respectively.
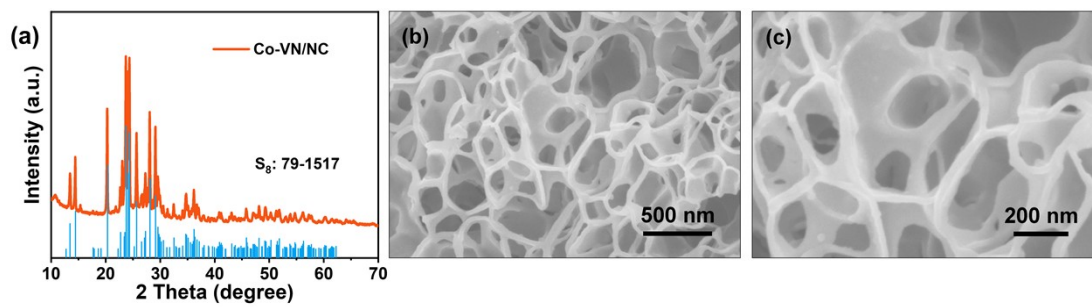
Figure S5. (a) XRD pattern of Co-VN/NC/S. (b, c) SEM images of Co-VN/NC/S at different magnifications.
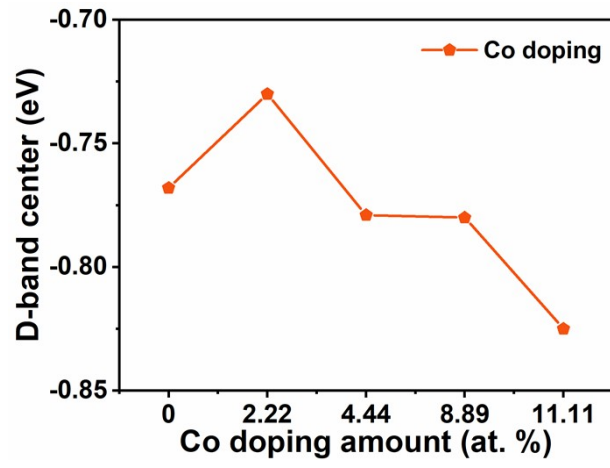
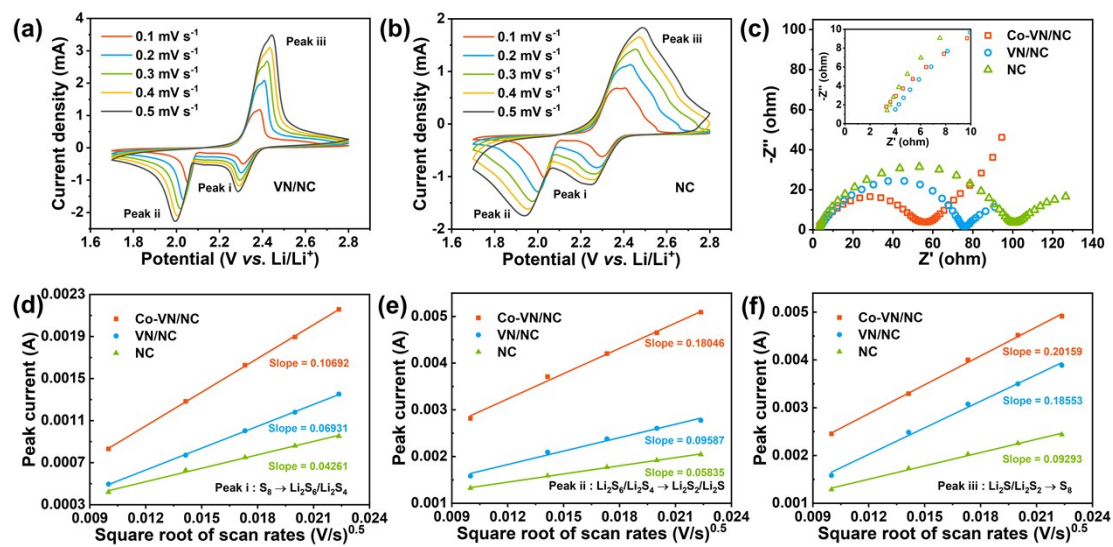**Figure S6.** The d band center of Co-VN with different Co doping ratios.

Figure S7. (a-b) CV curves of VN/NC and NC cathodes at different scan rates. (c) EIS curves were recorded for the three materials cathodes. (d-f) The corresponding linear fits of the peak currents to the square root of the scan rates.
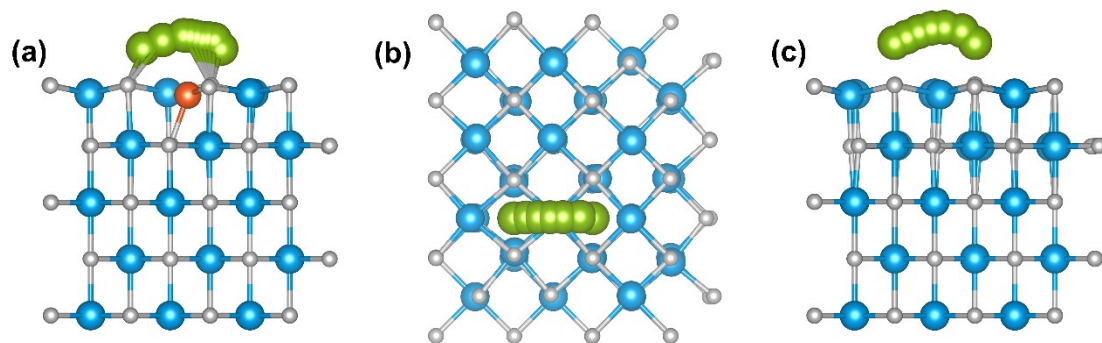
Figure S8. (a) Side view representations of Li-ion diffusion pathways on Co-VN (200) surfaces. (b-c) Top and side view representations of Li-ion diffusion pathways on VN (200) surfaces, respectively.
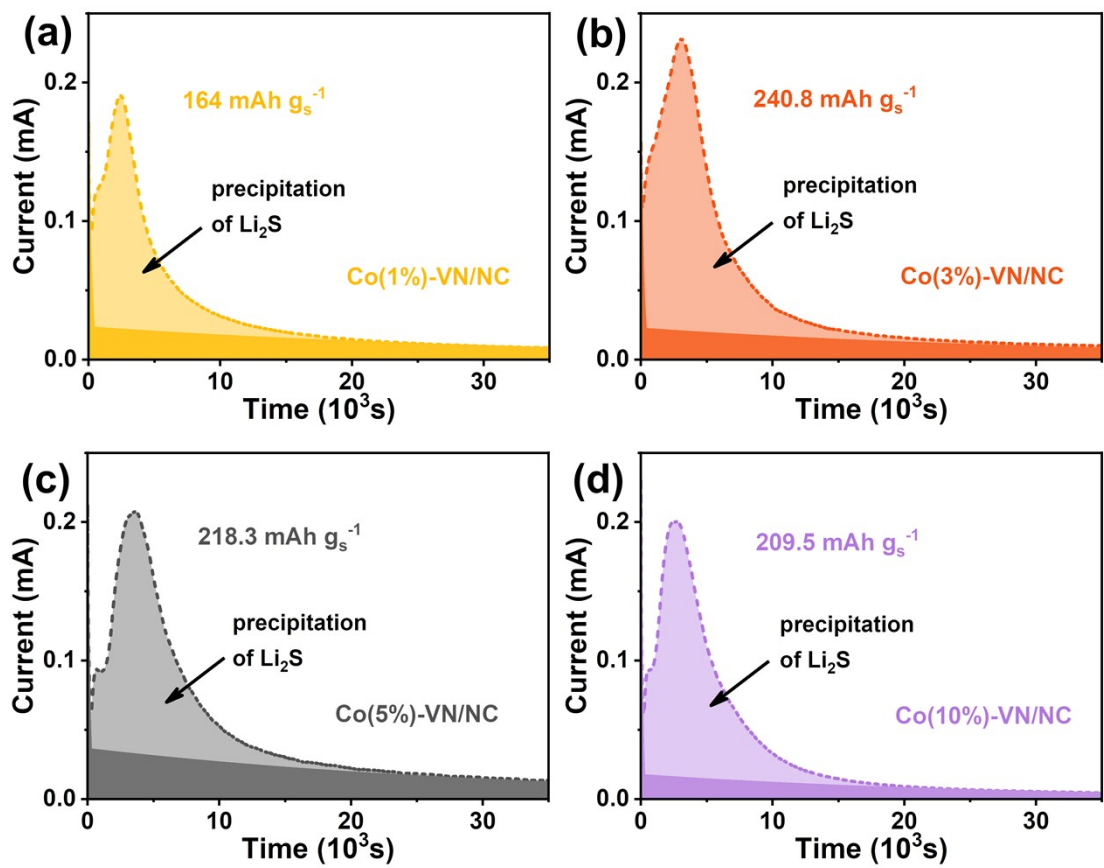
Figure S9. (a-d) Potentiostatic discharge curves of Co-VN/NC with different Co doping contents.

Table S1. The D_{li} values were calculated at the peaks i, ii, iii of Co-VN/NC, VN/NC and NC cathodes.

CV Peak	Co-VN/NC	VN/NC	NC
Peak i	1.632×10^{-8} cm^2/s	6.858×10^{-9} cm^2/s	2.592×10^{-9} cm^2/s
Peak ii	1.649×10^{-8} cm^2/s	1.312×10^{-8} cm^2/s	4.861×10^{-9} cm^2/s
Peak iii	5.802×10^{-8} cm^2/s	4.914×10^{-8} cm^2/s	1.233×10^{-8} cm^2/s

Table S2. Compared performance of 3D Co-VN/NC and other similar studies reported in Li-S batteries.

Sulfur cathodes	Sulfur content (wt%)	Capacity at 2 C (mAh g^{-1})	High sulfur loading (mg cm^{-2})	Areal capacity (mAh cm^{-2})	References
Co-VN@C	70	650	3.61	3.5 at 0.2 C	[1]
Co-NbN/rGO	72	702	3.7	4.42 at 0.2 C	[2]
Co-VN microflowers	69.2	706	4.42	~3.86 at 0.2 C	[3]
VN@N-PGC	72	832	—	—	[4]
VN/NG	70	962	3.2	3.86 at 0.2 C	[5]
VN/N-rGO	78	872	4.1	3.22 at 1 C	[6]
Porous laminated VN	80	832.7	4.3	~5.16 at 0.2 C	[7]
VN@NG	70	830	7.3	~4.4 at 0.2 C	[8]
3D Co-VN/NC	79.8	868	4.83	4.98 at 0.2 C	This work

Supplementary References

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