

## Supplementary Material

### **Binder-Free V<sub>2</sub>O<sub>5</sub>-Carbon Nanotube Composite Films for High-Performance Aqueous Manganese-Ion Batteries**

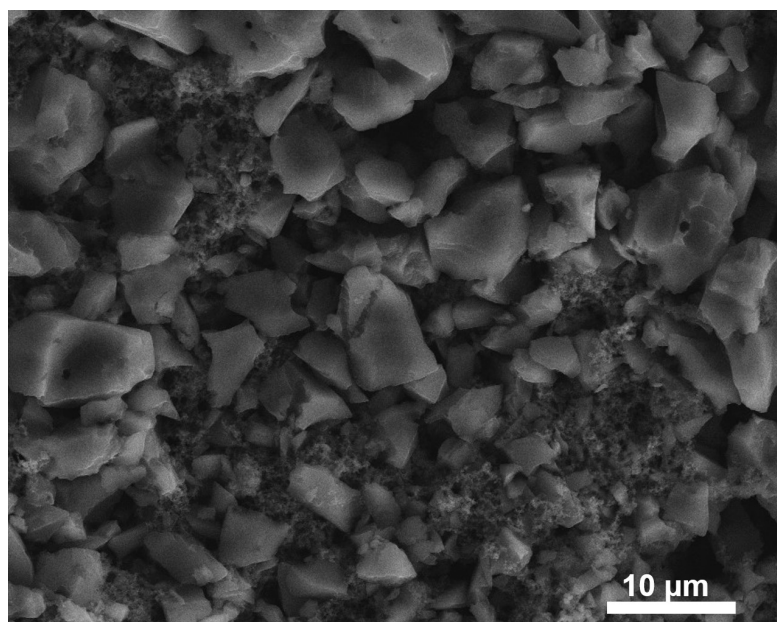
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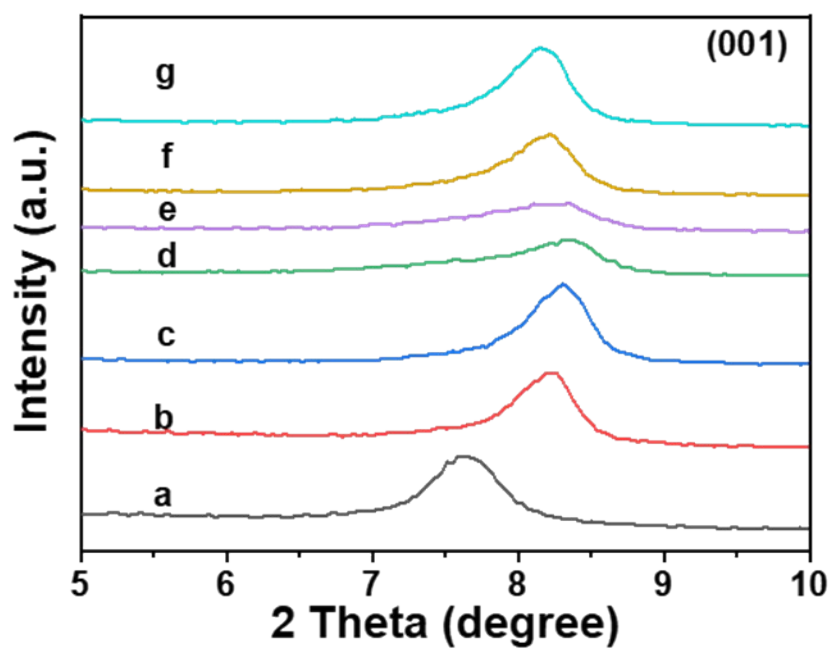
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**Figure S1.** SEM image of AC electrode.



**Figure S2.** XRD patterns of the (001) plane at different charge/discharge states.

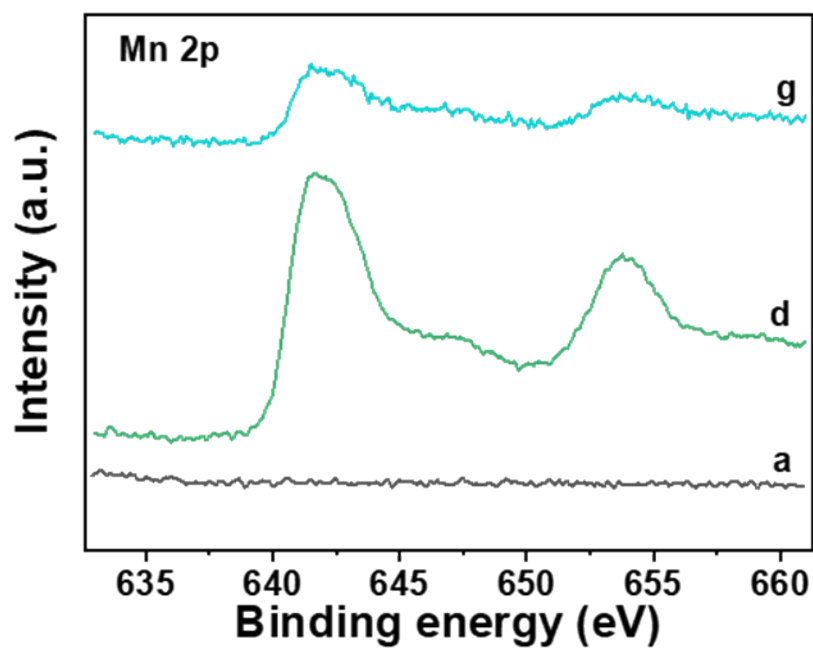


Figure S3. XPS spectra of Mn 2p at different charge/discharge states.

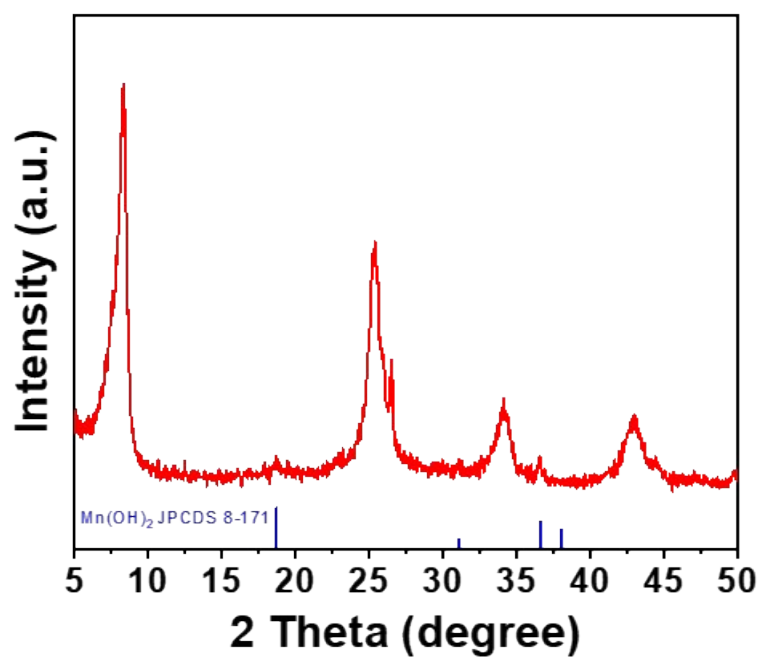
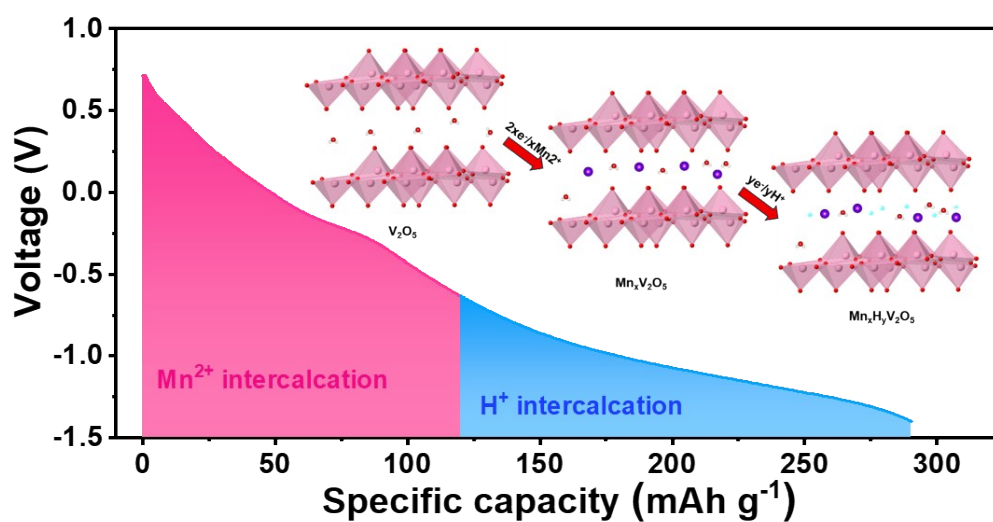
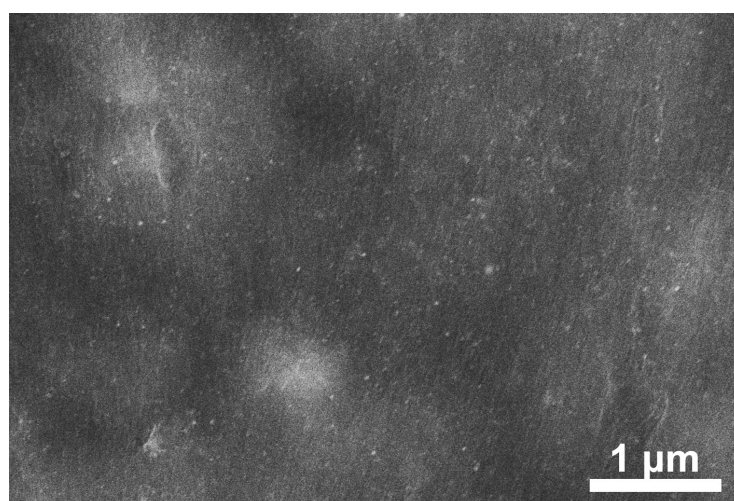


Figure S4. XRD patterns of the Mn(OH)<sub>2</sub>



**Figure S5.** Schematic diagram of the discharging mechanism of VO-CNT cathode.



**Figure S6.** SEM images of the VO-CNT cathode at fully charged states after 100 cycles.

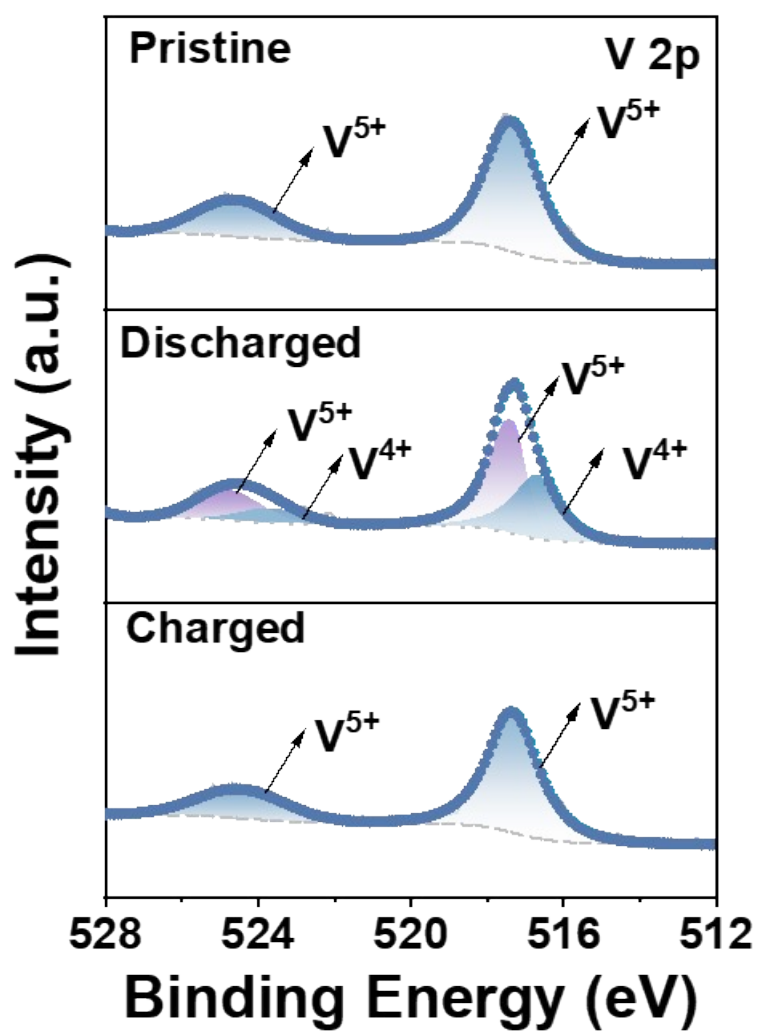


Figure S7. XPS V 2p spectra of VO-CNT cathode at the selected charge/discharge states.

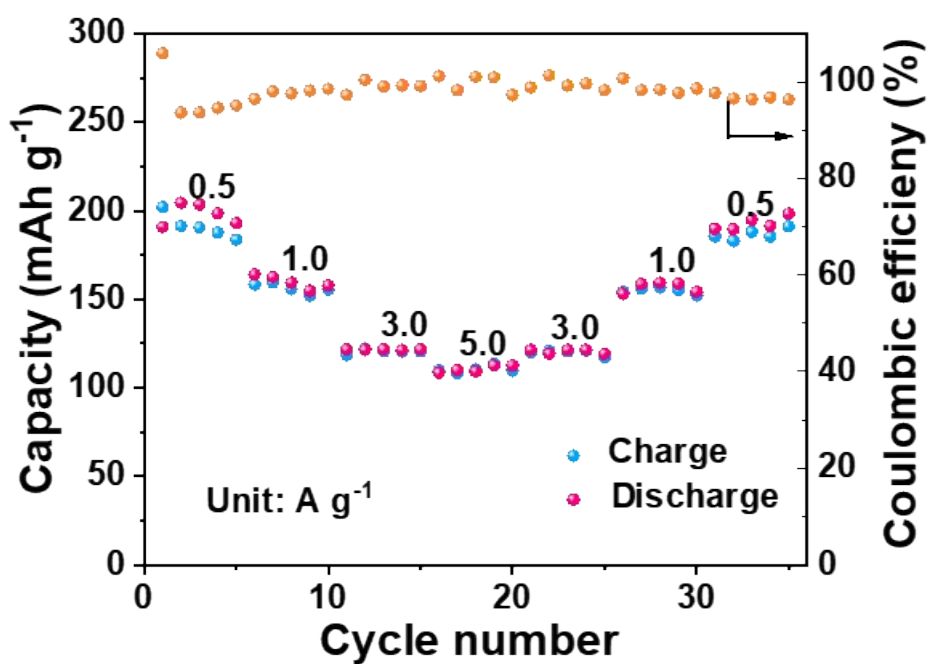
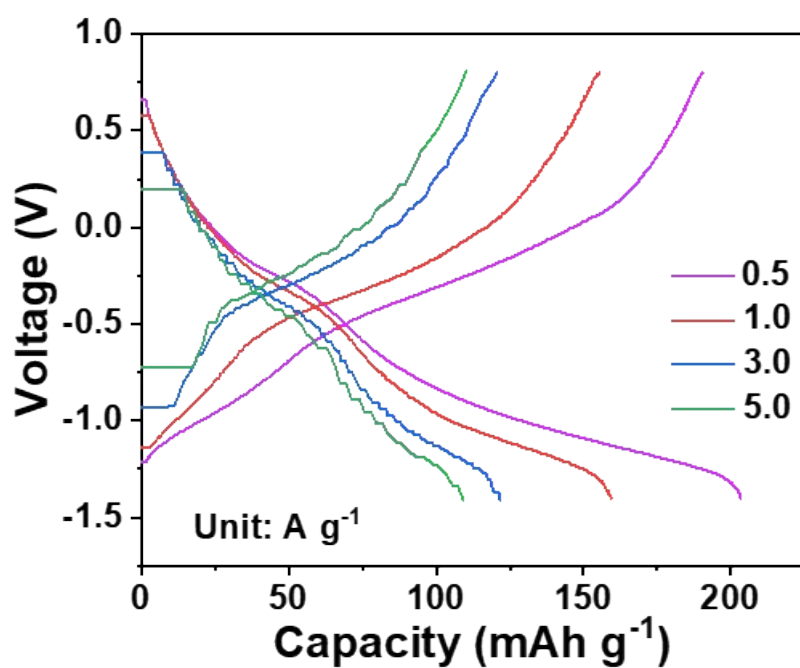
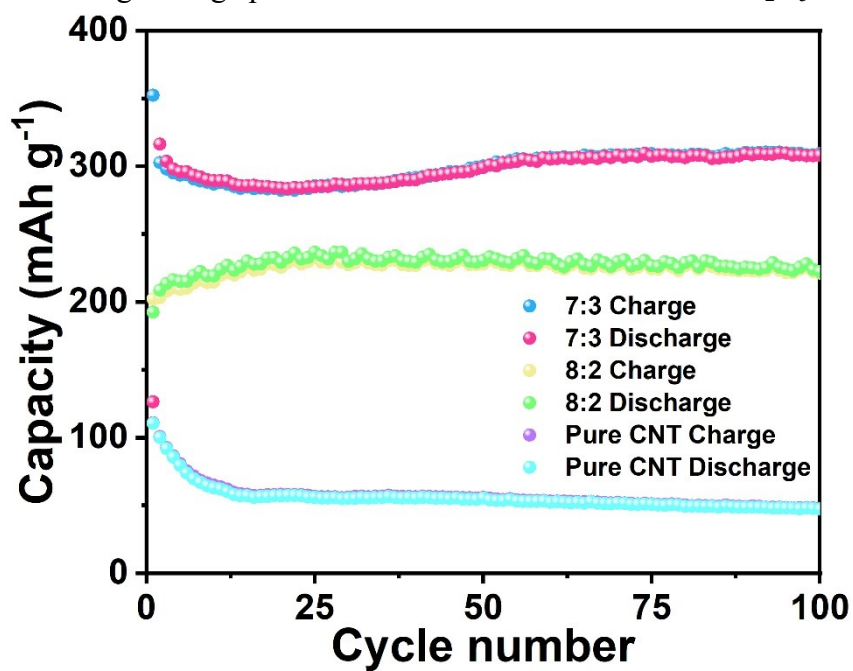


Figure S8. Rate capability of  $V_2O_5$  cathode.



**Figure S9.** Discharge/charge profiles at various current densities of  $V_2O_5$  cathode.



**Figure S10.** Cycling performance of VO-CNT films with different mass ratios at 1  $\text{A g}^{-1}$ .

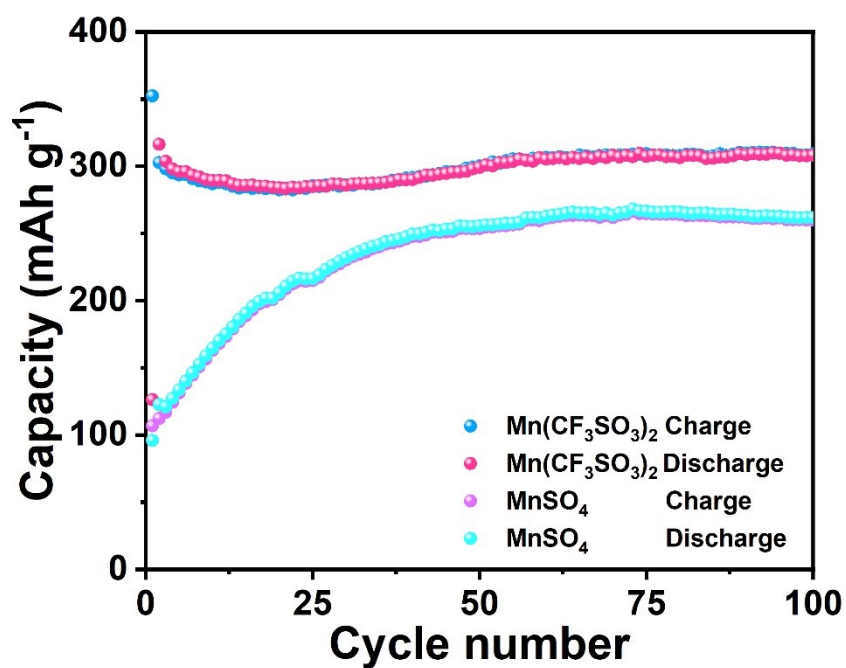


Figure S11. Cycling performance of VO-CNT films in different electrolytes at 1 A g<sup>-1</sup>.

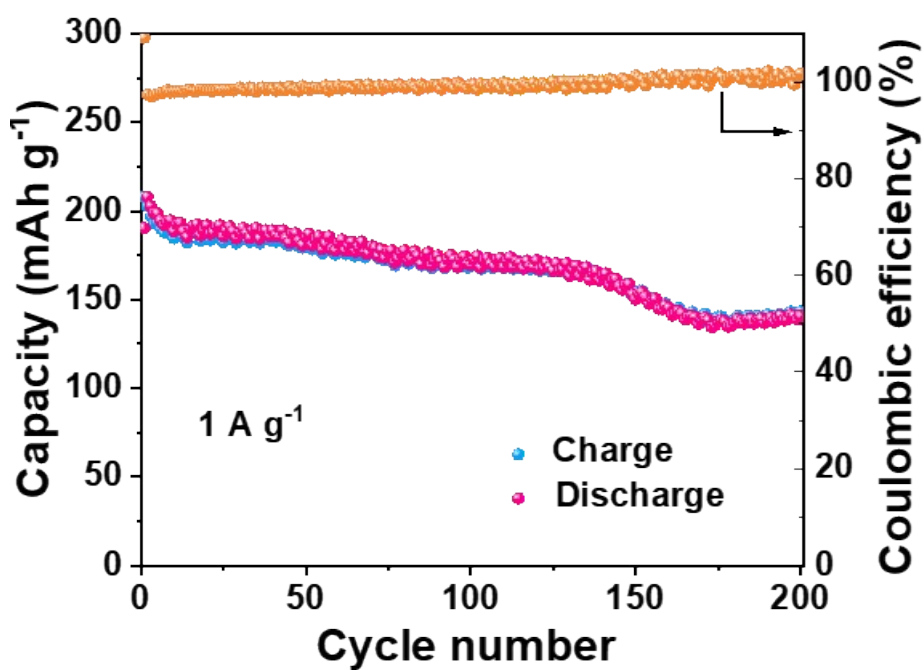


Figure S12. Cycling performance of V<sub>2</sub>O<sub>5</sub> cathode at 1.0 A g<sup>-1</sup>.

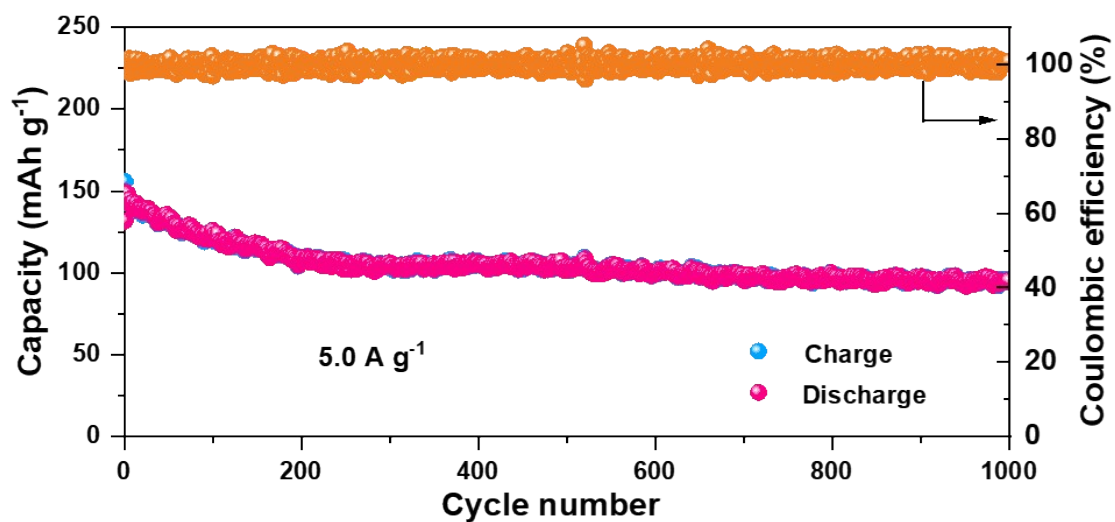


Figure S13. Cycling performance of  $\text{V}_2\text{O}_5$  cathode at  $5.0 \text{ A g}^{-1}$ .

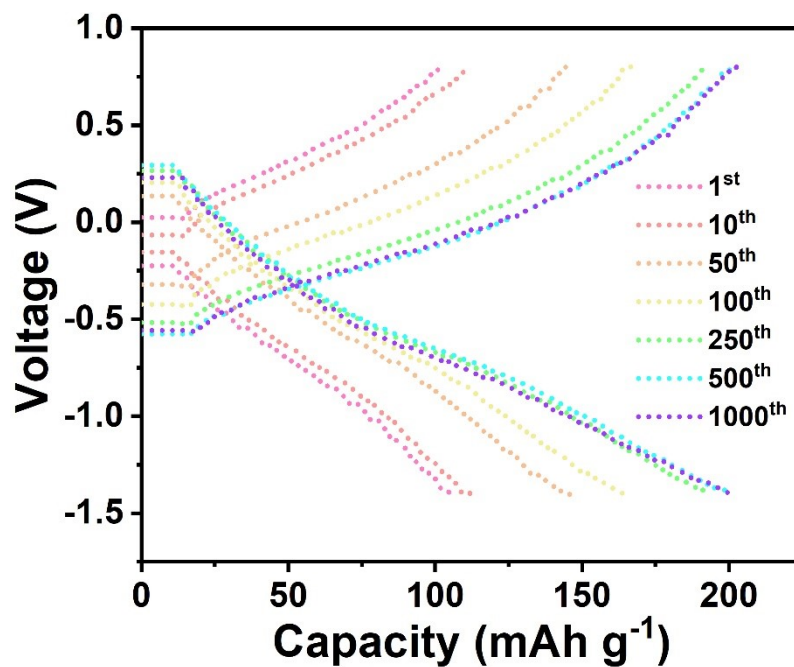


Figure S14. GCD curves of VO-CNT at different cycle numbers at  $5 \text{ A g}^{-1}$ .



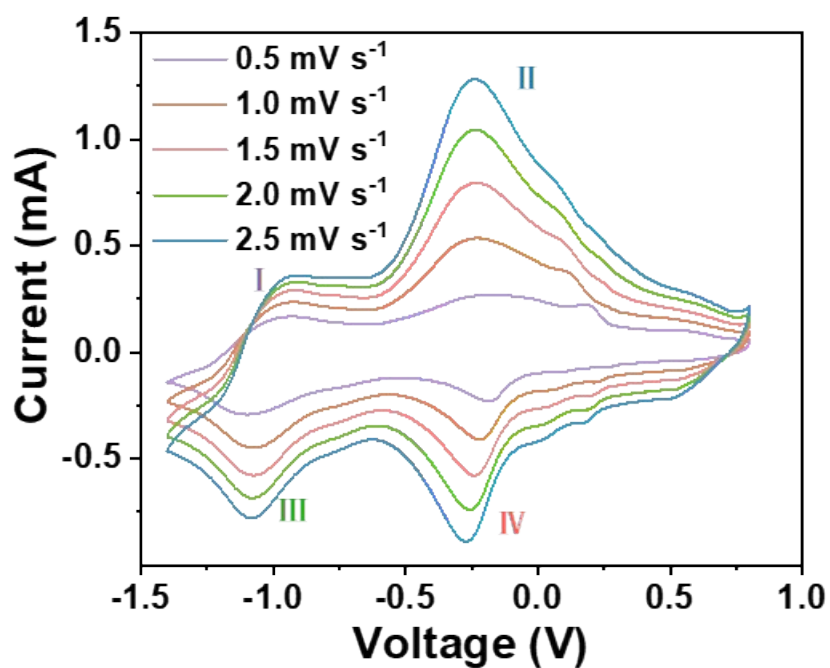


Figure S15. CV curves of  $V_2O_5$  cathode at different scan rates.

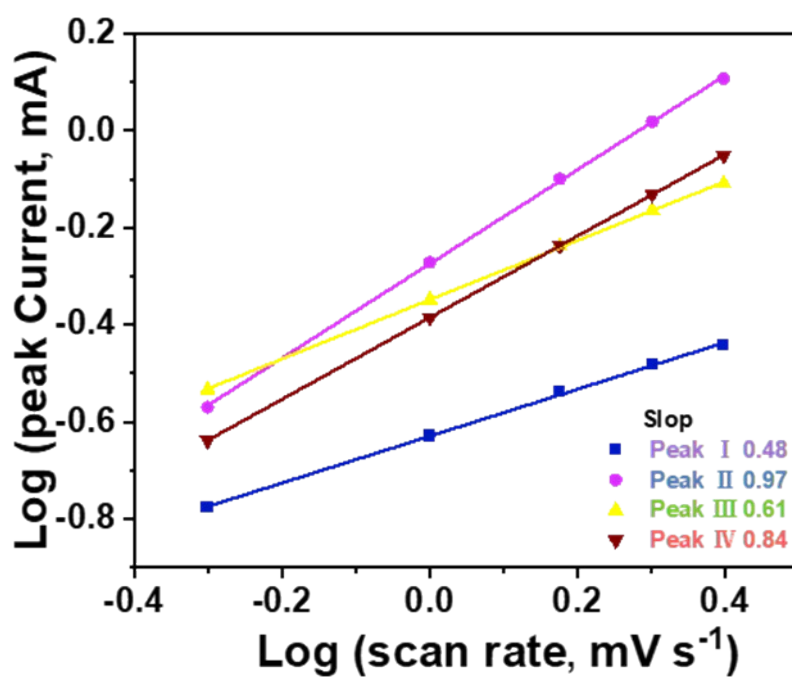
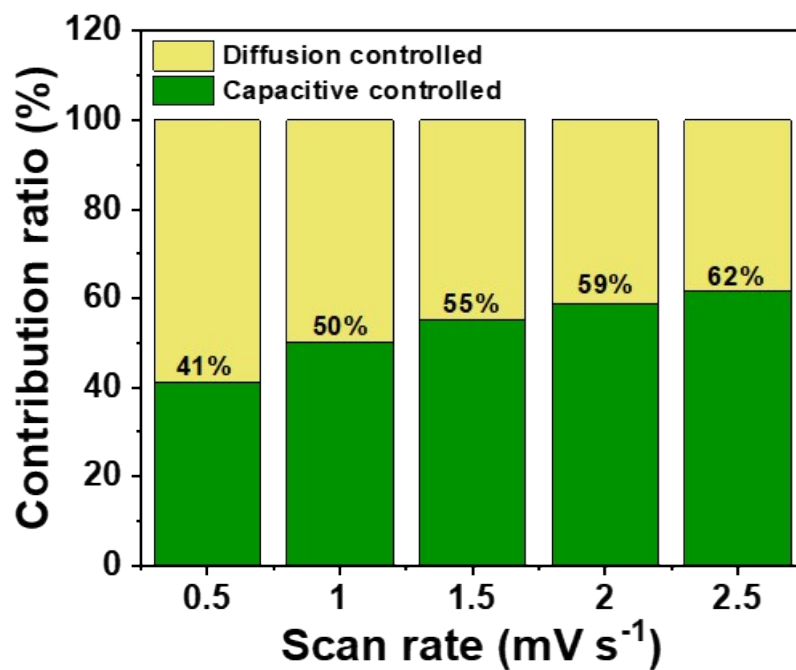
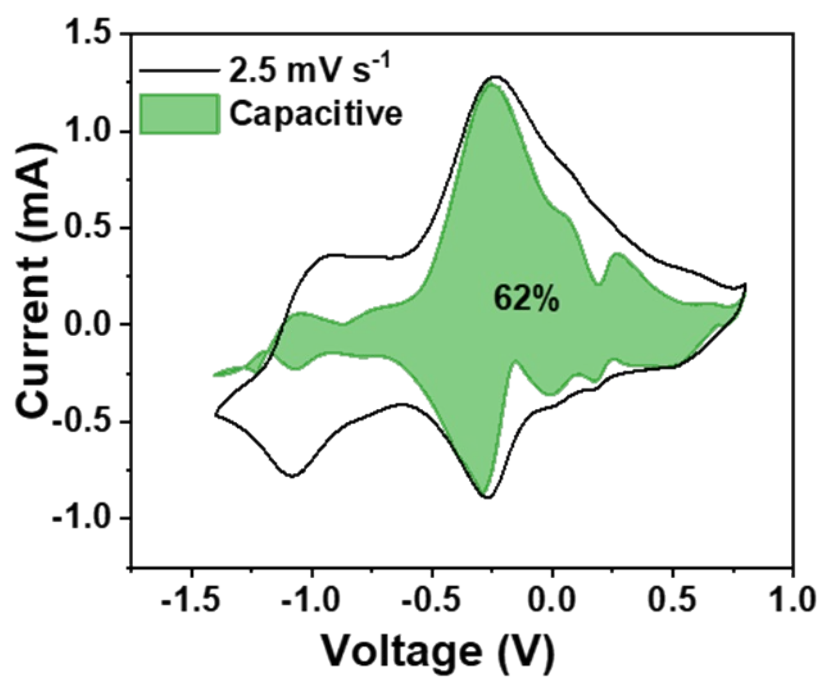


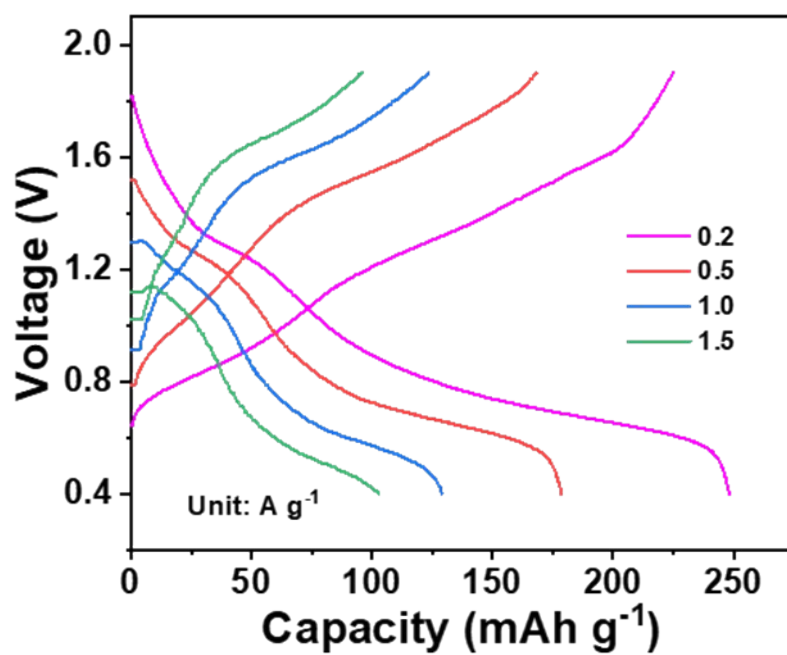
Figure S16. The corresponding plots of log (peak current) vs. log (scan rate) at each redox peak of  $V_2O_5$  cathode.



**Figure S17.** Capacitive contribution of  $V_2O_5$  cathode at different scan rates.



**Figure S18.** CV curve with a capacitive contribution of  $V_2O_5$  cathode at  $2.5 mV s^{-1}$ .



**Figure S19.** Discharge/charge profiles of  $V_2O_5$  cathode at various current densities.