Supplementary Information

Novel Charging-Optimized Cathode for Fast and High-Capacity Zinc-Ion Battery

Zhi Li,[a,‡] Buke Wu[b,‡] Mengyu Yan,[c] Liang He,[a,d] Lin Xu,[a] Guobin Zhang,[e] Tengfei Xiong,[f] Wen Luo[a,g], and Liqiang Mai[a]*

[a] State Key Laboratory of Advanced Technology for Materials Synthesis and Processing, Wuhan University of Technology, Wuhan 430070, China

[b]Department of Mechanical and Energy Engineering, Southern University of Science and Technology, Shenzhen, 518055, China

[c] Department of Materials Science and Engineering, University of Washington, Seattle, WA 98195, USA

[d] Department of Materials Science and NanoEngineering, Rice University, Houston, TX 77005, USA

[e] Department of Material Science and Engineering, City University of Hong Kong, Kowloon, Hong Kong, 99077 China

[f] Department of Chemistry, City University of Hong Kong, Kowloon, Hong Kong, 99077, China

[g] Department of Physics, School of Science, Wuhan University of Technology, Wuhan 430070, China

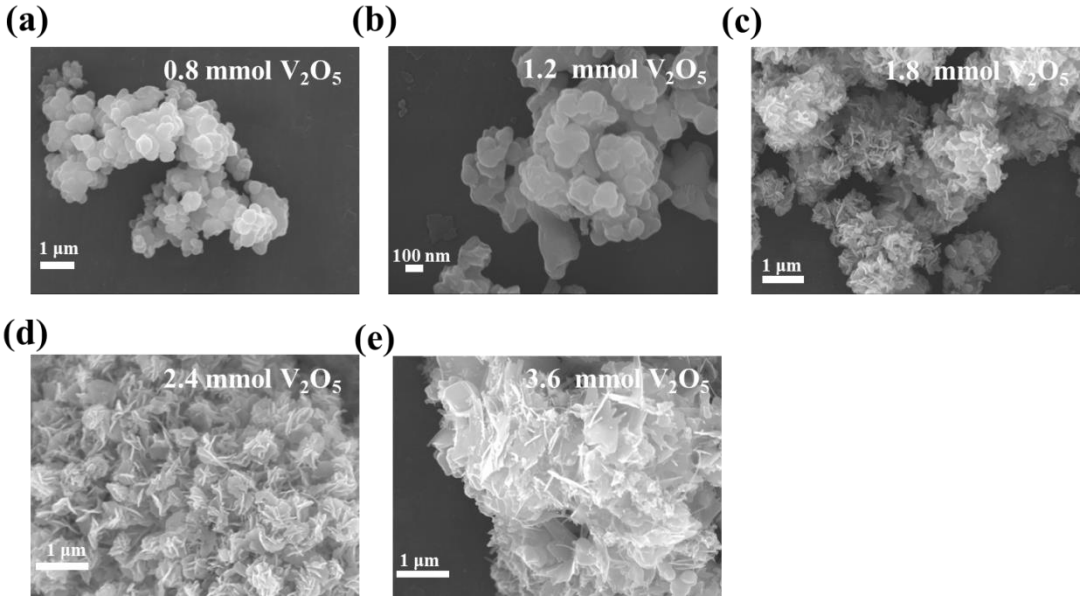

Figure S1. SEM images of $K_2V_3O_8$ synthesized with different concentrations of V_2O_5: (a) 0.8 mmol; (b) 1.2 mmol; (c) 1.8 mmol; (d) 2.4 mmol; (e) 3.6 mmol (with a fixed molar proportion, KOH : V_2O_5 = 4 : 3).

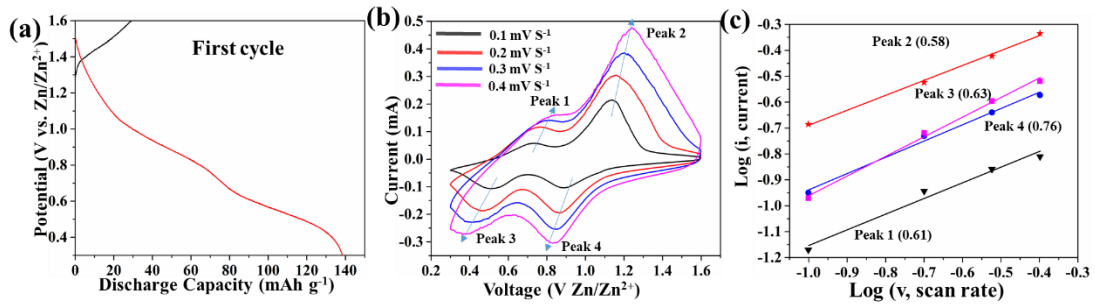

Figure S2. (a) The charge-discharge curve of $K_2V_3O_8$ for the first cycle, (b) the CV curves at scan rates of 0.1, 0.2, 0.3 and 0.4 mV s^{-1} in 0.3 - 1.6 V and (c) the peak currents versus scan rates to determine the *b*-value of the anodic and cathodic peaks of $K_2V_3O_8$ cathode.

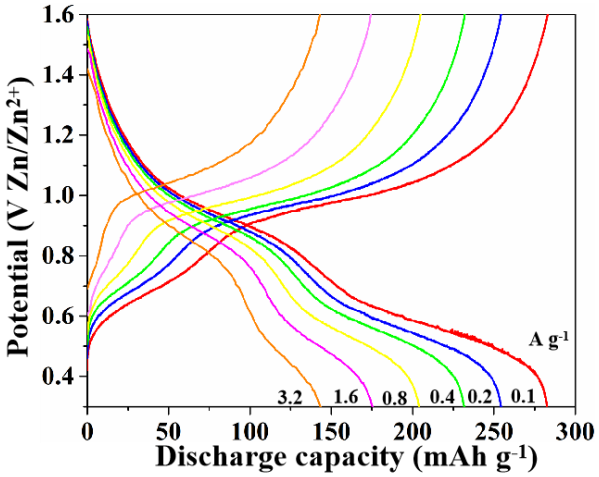

Figure S3. The charge-discharge curve of Zn//$K_2V_3O_8$ battery at different rates.

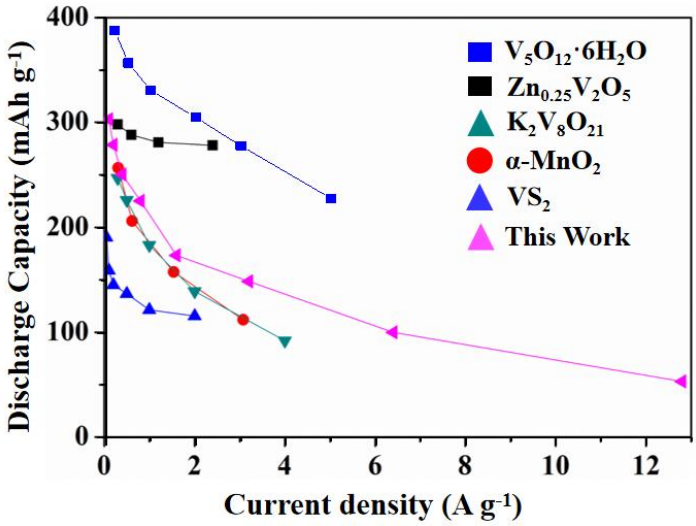

Figure S4 is corrected as suggested

Figure S4. Comparison of rate performance with other representative Zn-storage cathode materials.

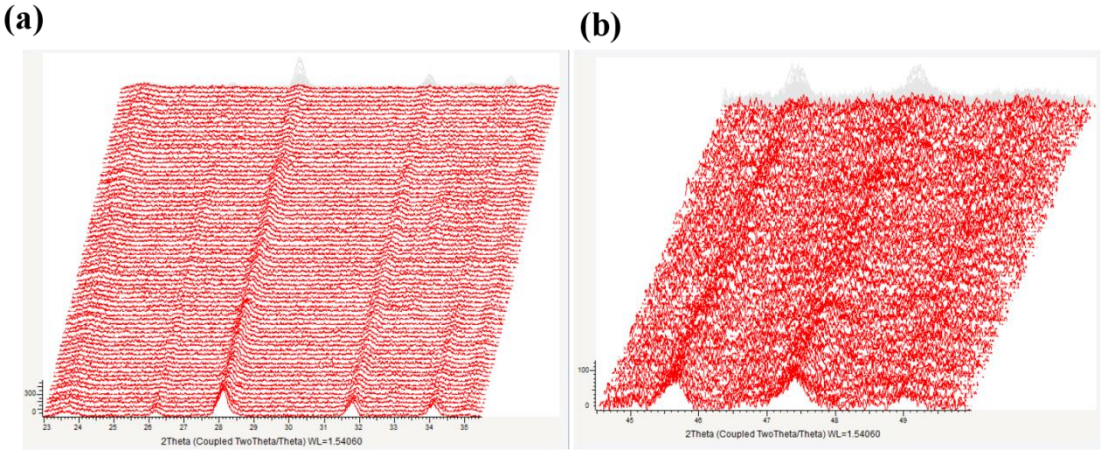

Figure S5. Waterfall plot of *in-situ* XRD ranging from 23^{o} -35.5^{o} (a), and waterfall plot of *in-situ* XRD ranging from 44.5^{o} -50^{o} (b).

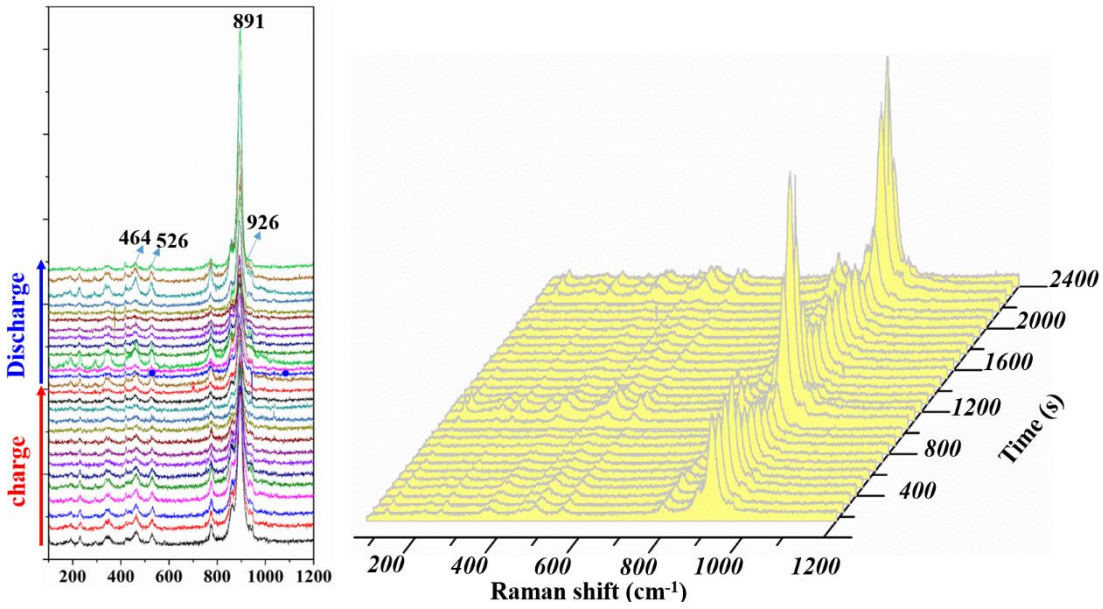

Figure S6. Waterfall plot of electrochemical *in-situ* Raman spectra of $K_2V_3O_8$ cathode.

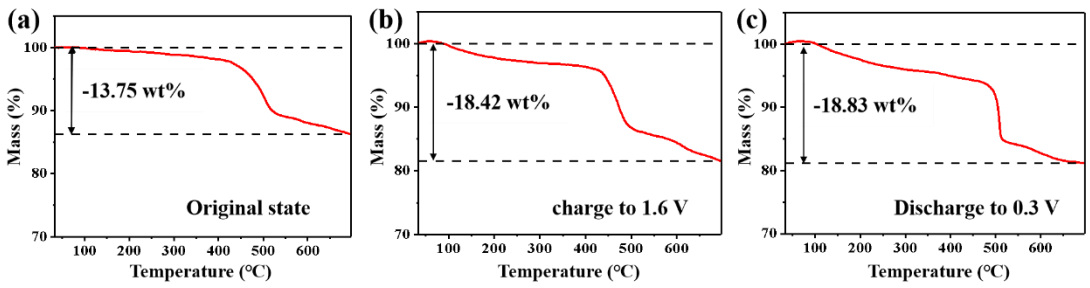

Figure S7. TGA results of electrodes at the original state (a), 1.6 V-charged-state (b) and 0.3 V-discharged-state (c).

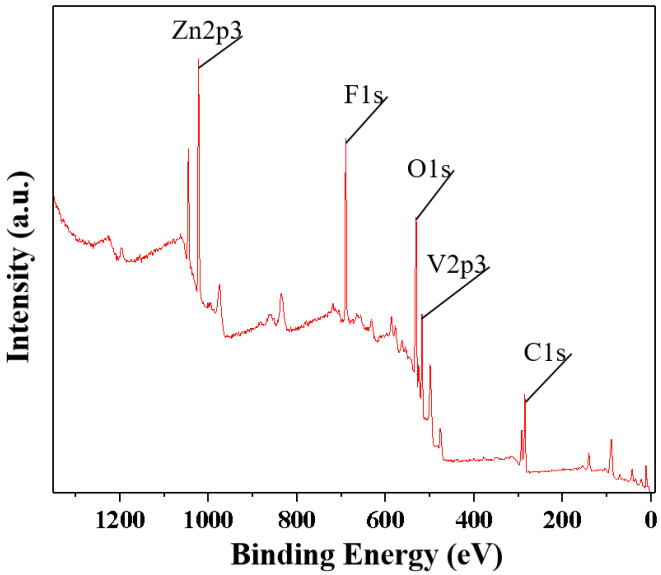

Figure S8 is added as suggested

Figure S8. XPS spectrum for all detected elements of the original $K_2V_3O_8$ cathode slice.