
Sn-doped Hydrated V₂O₅ Cathode Material with Enhanced Rate and Cycling Properties for Zinc-Ion Batteries

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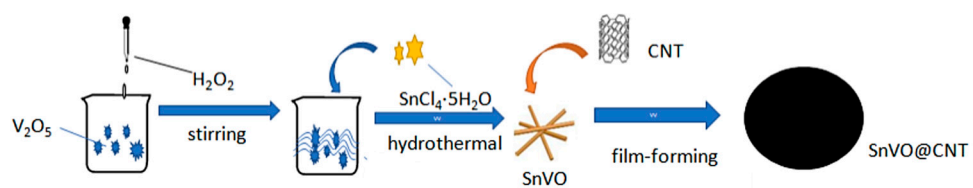


Figure S1. Scheme of synthesis of SnVOH

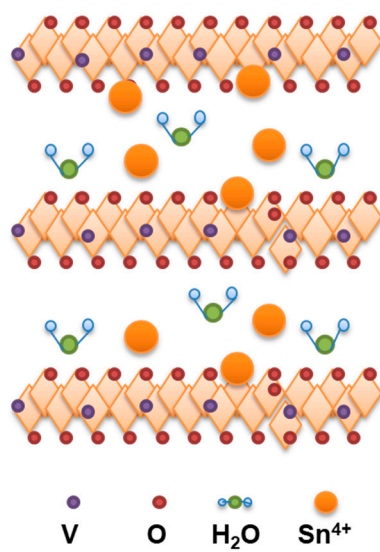


Figure S2. The schematic crystalline structure of SnVOH

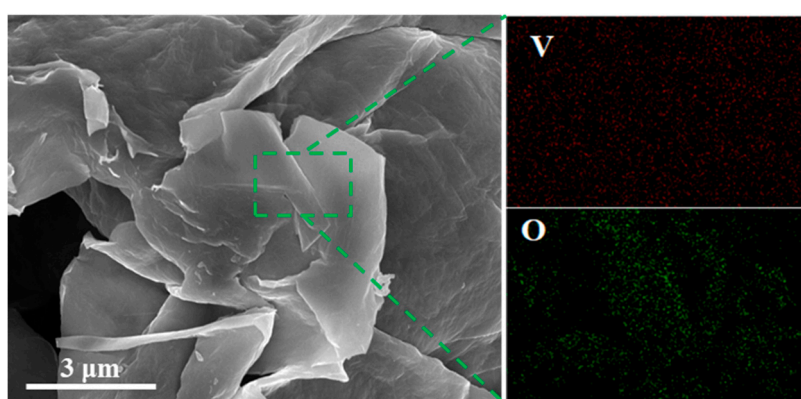


Figure S3. EDS characterization of VOH sample.

Table S1. The molar ratio of different elements in SnVOH

Map Sum Spectrum		
Element	Wt%	Atomic%
O	36.33	67.79
V	48.36	28.36
Sn	15.31	3.85
Total:	100.00	100.00

The interplanar distance d of (001) plane is calculated with the Bragg Equation:

$$d_{001} = \lambda / 2 \sin \theta \quad (1)$$

The wave length of Cu $K\alpha$ ray λ is 0.154178 nm.

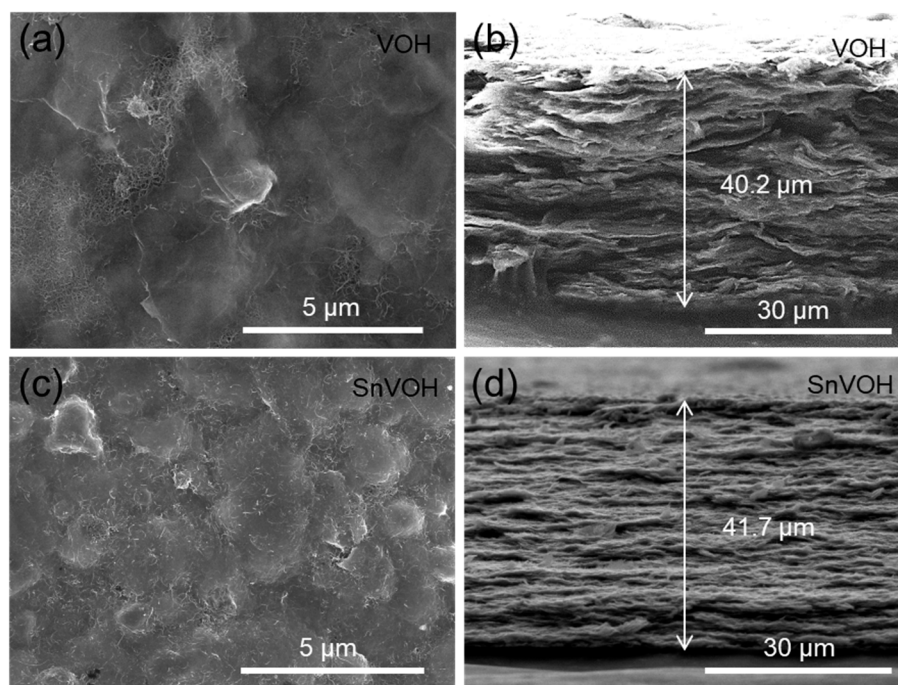


Figure S4. Characterization of VOH and SnVOH composite cathodes. (a) Top and (b) side-view SEM of VOH-based cathode. (c) Top and (d) side-view SEM of SnVOH-based cathode.

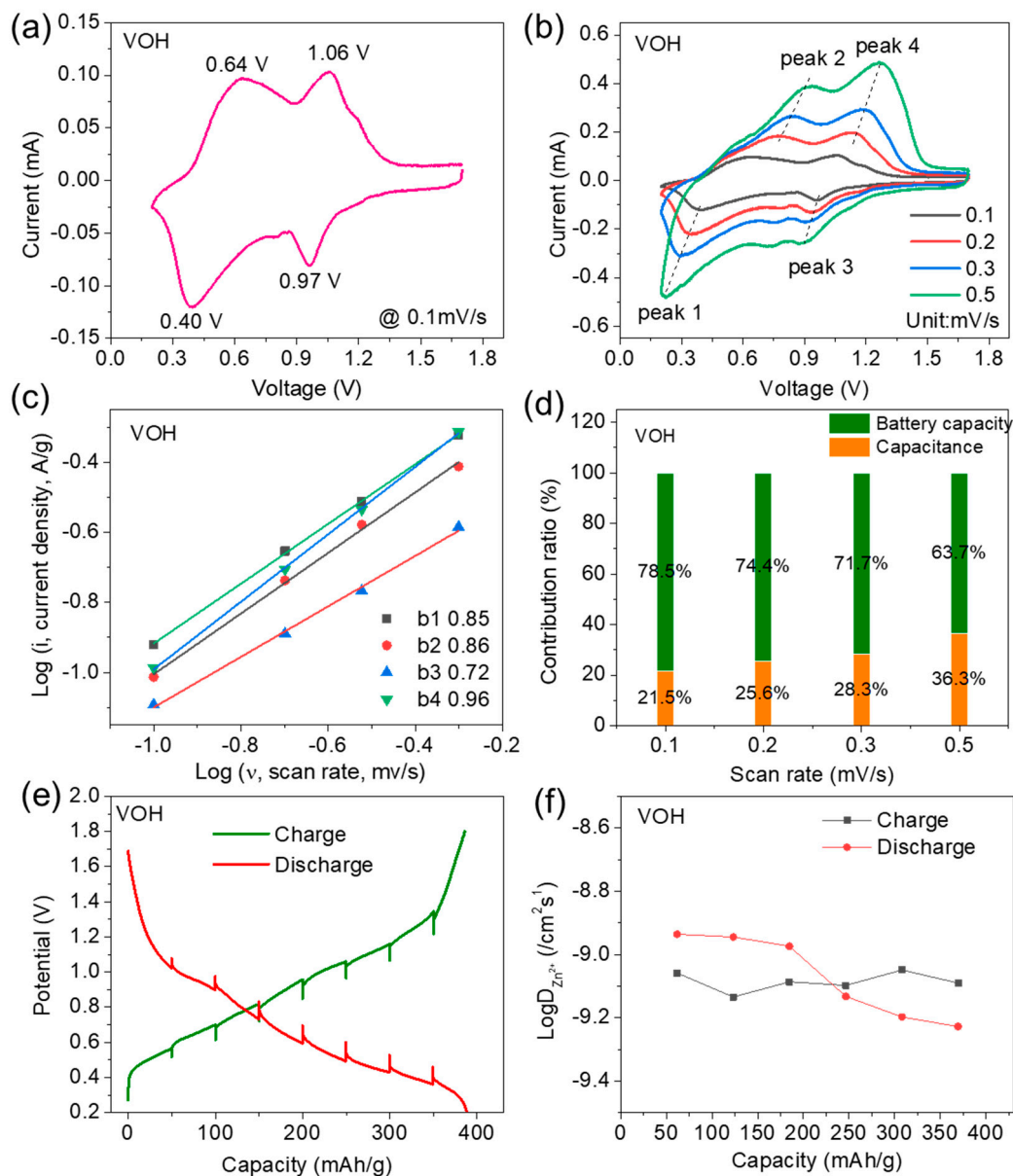


Figure S5. Electrochemical characterization of VOH-based cathode. (a) CV profile at the scan rate of 0.1 mV/s, (b) CV curves at the scan rate from 0.1 to 0.5 mV/s, (c) $\log(\text{current})$ vs. $\log(\text{scan rate})$ plots of four peaks in CV curves during the cycles, (d) capacity contribution ratios of battery type capacity and capacitance, (e) GITT profile of VOH, (f) Zn^{2+} diffusion coefficient in the VOH.

Table S2. Electrochemical performance comparison of SnVOH with recent literature data on doped hydrated V₂O₅-based cathodes in ZIBs.

Cathode Material	Specific capacity	Rate performance	Cycle performance	Ref.
SnVOH	376 mAhg ⁻¹ at 0.1 Ag ⁻¹	290 mAhg ⁻¹ at 10 Ag ⁻¹	135%, 500 cycles at 10 Ag ⁻¹ ; 71%, 2500 cycles at 5 Ag ⁻¹	This work
Mn _{0.15} V ₂ O ₅ ·nH ₂ O	367 mAhg ⁻¹ at 0.1 Ag ⁻¹	150 mAhg ⁻¹ at 10 Ag ⁻¹	150% (153 mAhg ⁻¹), 8000 cycles at 10 Ag ⁻¹	1
Fe _x V ₂ O ₅ ·nH ₂ O	311.1 mAhg ⁻¹ at 0.1 Ag ⁻¹	201.6 mAhg ⁻¹ at 3 Ag ⁻¹	88.7%, 1500 cycles at 2 Ag ⁻¹	2
(NH ₄) _x V ₂ O ₅ ·nH ₂ O	388 mAhg ⁻¹ at 0.5 Ag ⁻¹	104 mAhg ⁻¹ at 5 Ag ⁻¹	53%, 400 cycles at 2Ag ⁻¹	3
Mg _{0.34} V ₂ O ₅ ·0.84H ₂ O	353 mAhg ⁻¹ at 0.5 Ag ⁻¹	81 mAhg ⁻¹ at 5 Ag ⁻¹	97%, 2000 cycles at 5 Ag ⁻¹	4
Na _x V ₂ O ₅ ·nH ₂ O	459.1 mAhg ⁻¹ at 0.5 Ag ⁻¹	352.5 mAhg ⁻¹ at 10 Ag ⁻¹	83.1%, 1800 cycles at 10 Ag ⁻¹	5
Ca _x V ₂ O ₅ ·nH ₂ O	310 mAhg ⁻¹ at 0.5 Ag ⁻¹	88 mAhg ⁻¹ at 15 Ag ⁻¹	91.7%, 3000 cycles at 10 Ag ⁻¹	6
Zn _{0.25} V ₂ O ₅ ·H ₂ O	300 mAhg ⁻¹ at 0.11 Ag ⁻¹	175 mAhg ⁻¹ at 2.5 Ag ⁻¹	92%, 200 cycles at 0.5 Ag ⁻¹	7
Li _{0.25} V ₂ O ₅ ·H ₂ O	470 mAhg ⁻¹ at 0.5 Ag ⁻¹	170 mAhg ⁻¹ at 10 Ag ⁻¹	64%, 1000 cycles at 10 Ag ⁻¹	8

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