

ADVANCED ENERGY MATERIALS

Supporting Information

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Layered VS₂ Nanosheet-Based Aqueous Zn Ion Battery
Cathode

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Chen, Qinyou An,* and Liqiang Mai**

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Experimental Section

Synthesis of VS₂ nanosheets: VS₂ nanosheets were prepared via a simple hydrothermal method. Briefly, 2 mmol NH₄VO₃ was dissolved in 30 ml deionized water and 2 mL NH₃·H₂O in a glass jar. Then, 15 mmol thioacetamide (TAA) was added in the homogeneous solution with continuous magnetic stirring at room temperature for 1 h. After that, the mixture was transferred to a 50 mL Teflon-lined sealed autoclave and maintained at 180°C for 20 h. Afterward, the system was cooled down to room temperature naturally and the samples were washed with distilled water and ethanol thoroughly for 3 times, respectively. The final product was dried at 60°C for 8 h in vacuum, and the black powder was obtained.

Material characterizations: The as-prepared samples were characterized by power X-ray diffraction (XRD, D8 Discover X-ray diffractometer with Cu K_α radiation), X-ray photoelectron spectroscopy (XPS, Thermo Scientific Escalab 250Xi), Raman spectra (Renishaw INVIA), field emission scanning electron microscopy (FESEM, JSM-7100F) transmission electron microscopy (TEM) and energy dispersive spectroscopy (JEM-2100F, STEM/EDS).

Electrochemical characterizations: The VS₂ electrode was prepared by mixing VS₂ (60 wt%), acetylene black (Super-P, 30 wt%), and poly tetrafluoroethylene (PTFE, 10 wt%), then the slurry was evenly grinded, tableted and cut into Φ10 mm electrodes. Zinc foil and glass fiber membrane were used as the anode and separator, respectively, and 1 M zinc sulfate electrolyte solution was used as the electrolyte. A CR2016-type coin cell was assembled in the air atmosphere to evaluate the electrochemical performance on a LAND battery testing system (CT2001A). Cyclic voltammograms (CV) were test on a CHI600E electrochemical workstation. All of the tests were performed at room temperature.

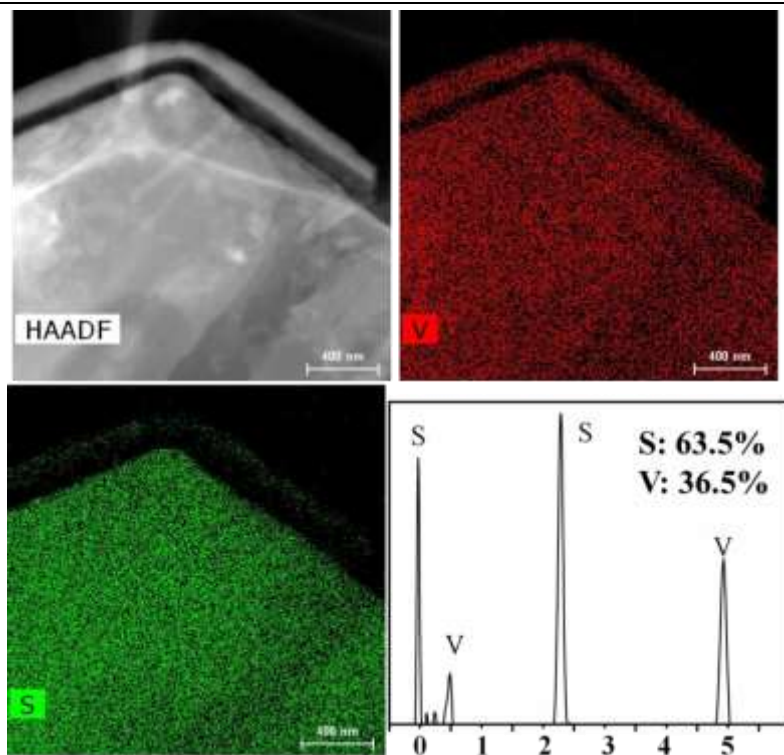


Figure S1. TEM-EDS of VS₂ nanosheets

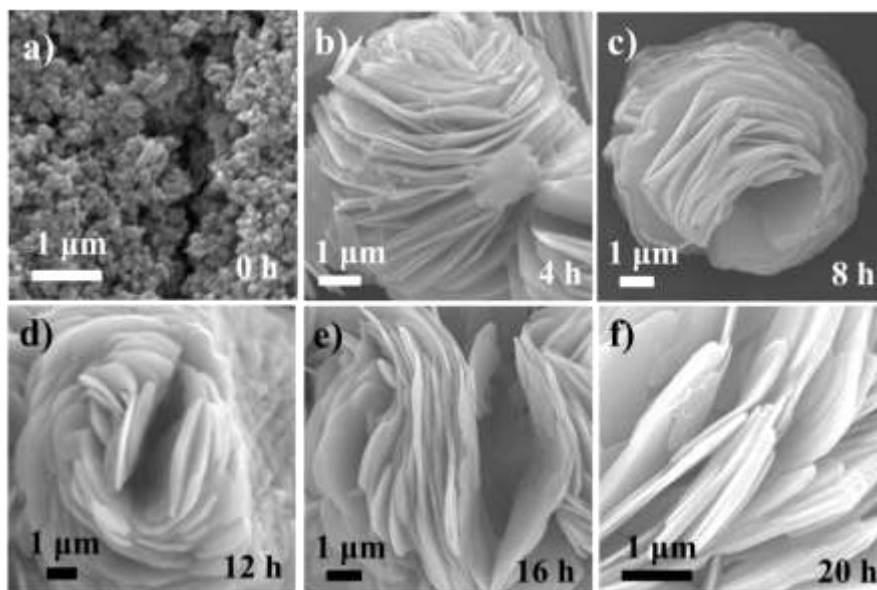
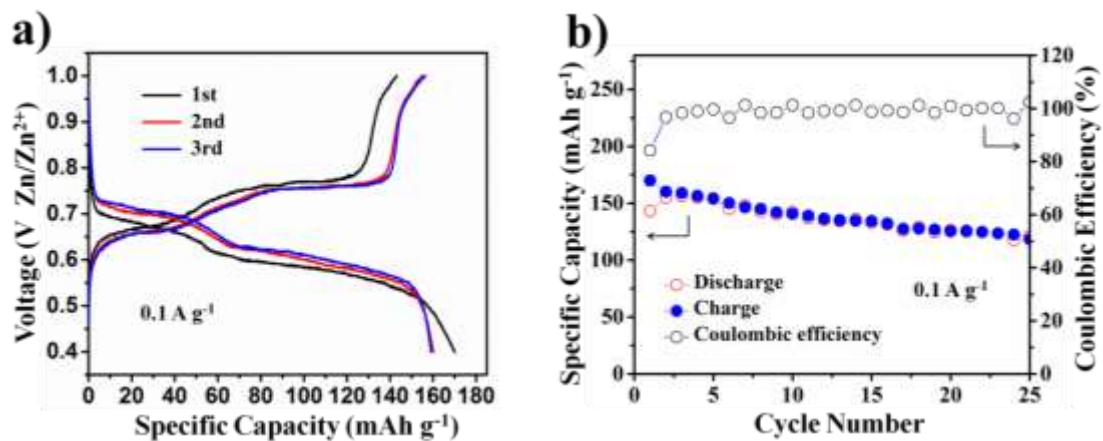


Figure S2. The growth process of VS₂ nanosheets at different reaction times (from 0 h to 20 h).



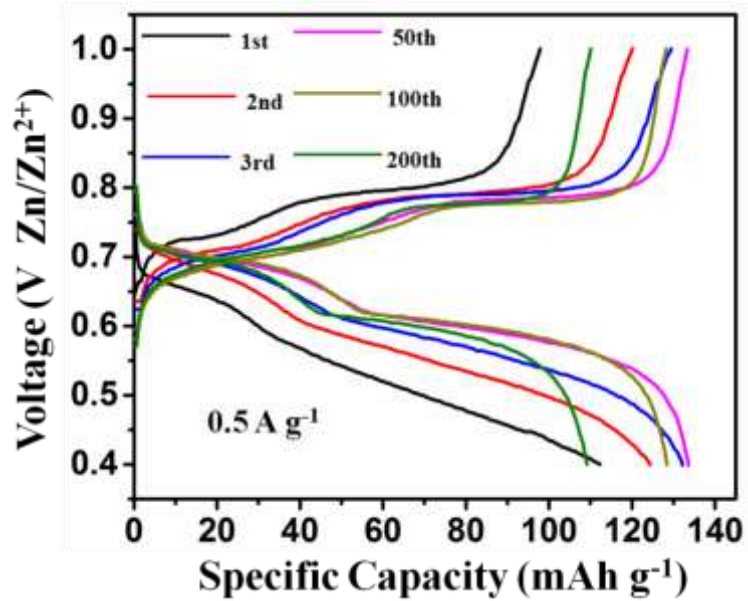


Figure S4. The charge and discharge curves of VS₂ of different cycles at a current density of 0.5 A g⁻¹.

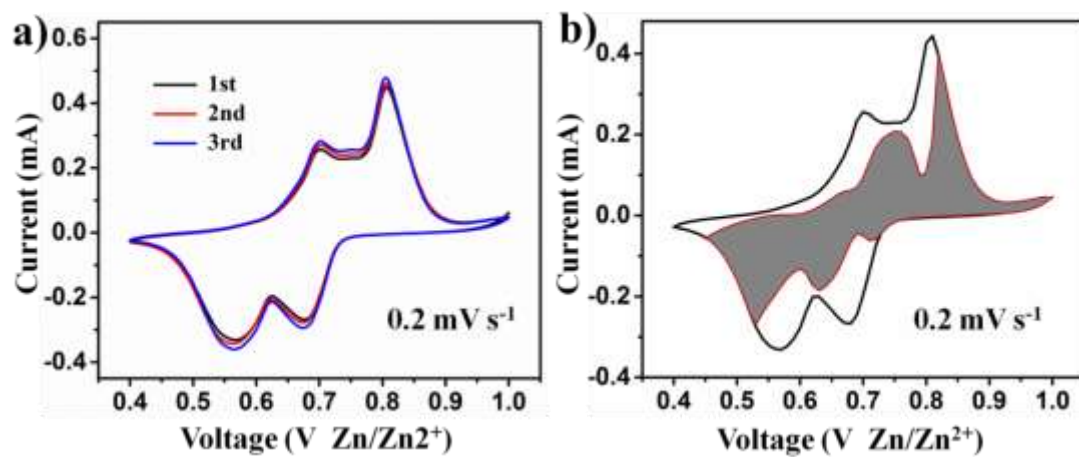


Figure S5. a) The CV curves of VS₂ at a scan rate of 0.1 mV/s, b) The contribution ratio of the capacitive capacities and diffusion-limited capacities at 0.1 mV/s.

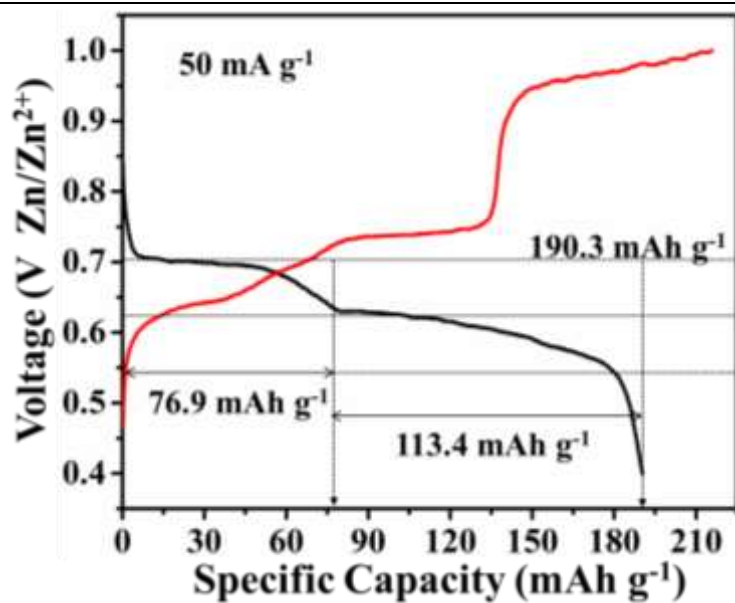


Figure S6. The charge and discharge curves of VS_2 at 0.05 A g^{-1} .

In the first step: $\text{VS}_2 + x\text{Zn}^{2+} + 2xe^- \leftrightarrow \text{Zn}_x\text{VS}$ ($x = 0.09$)

In the second step: $\text{Zn}_x\text{VS}_2 + y\text{Zn}^{2+} + 2ye^- \leftrightarrow \text{Zn}_{x+y}\text{VS}_2$ ($y = 0.14$)

x and y are calculated based on the following equations:

($F = N_A \cdot e = 96500 \text{ C/mol}$, $N_A = 6.02 \times 10^{23}$, $1 \text{ A h} = 1 \text{ A} \times 3600 \text{ s} = 3600 \text{ C}$, $C_0 = 26.8 \text{ nm/M}$)