ADVANCED ENERGY MATERIALS

Supporting Information

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Layered VS_2 Nanosheet-Based Aqueous Zn Ion Battery Cathode

Pan He, Mengyu Yan, Guobin Zhang, Ruimin Sun, Lineng Chen, Qinyou An, and Liqiang Mai**

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Experimental Section

Synthesis of VS_2 nanosheets: VS_2 nanosheets were prepared via a simple hydrothermal method. Briefly, 2 mmol NH_4VO_3 was dissolved in 30 ml deionized water and 2 mL $NH_3.H_2O$ 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℃ 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^{o}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 VS_2 electrode was prepared by mixing VS_2 (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.

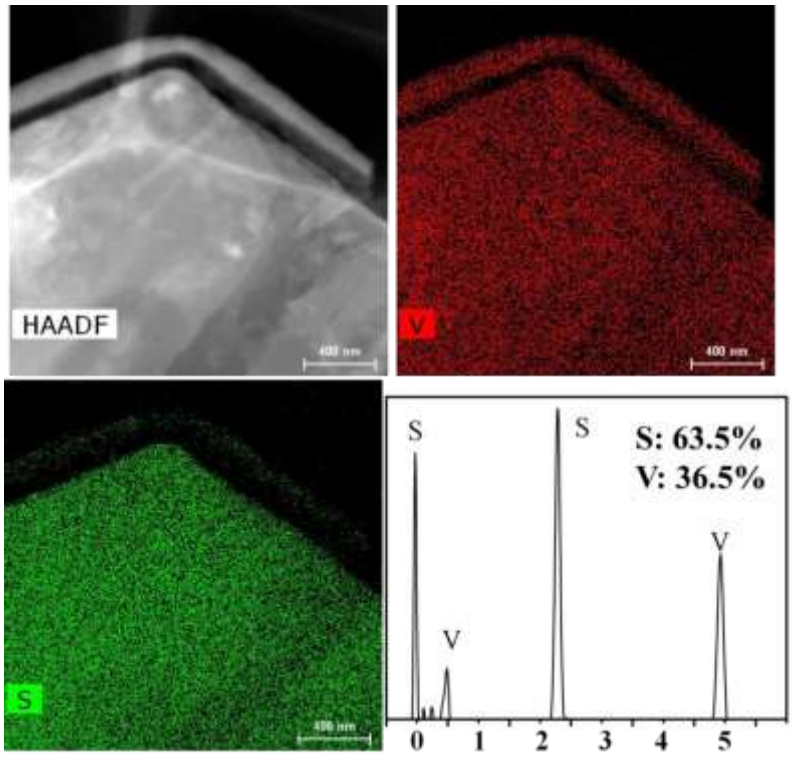

Figure S1. TEM-EDS of VS_2 nanosheets

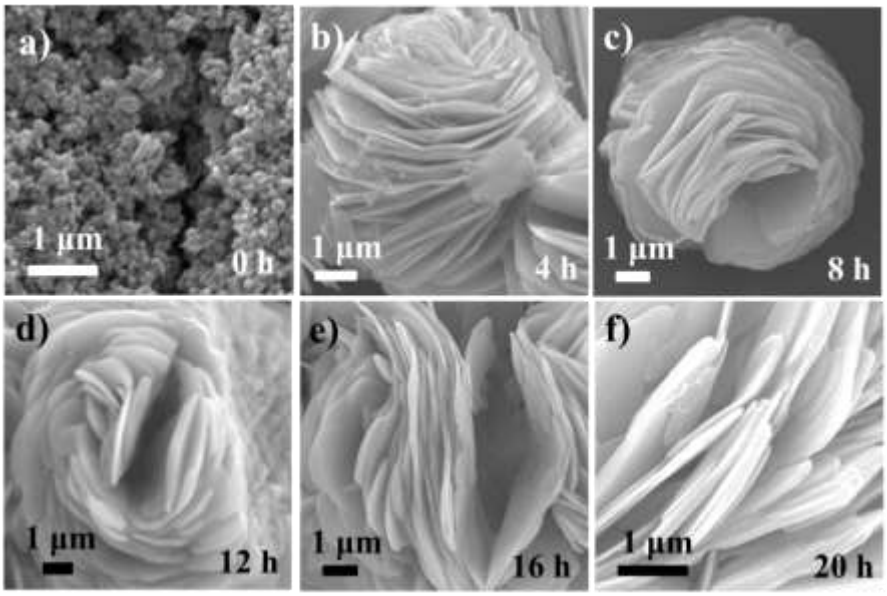

Figure S2. The growth process of VS_2 nanosheets at different reaction times (from 0 h to 20 h).

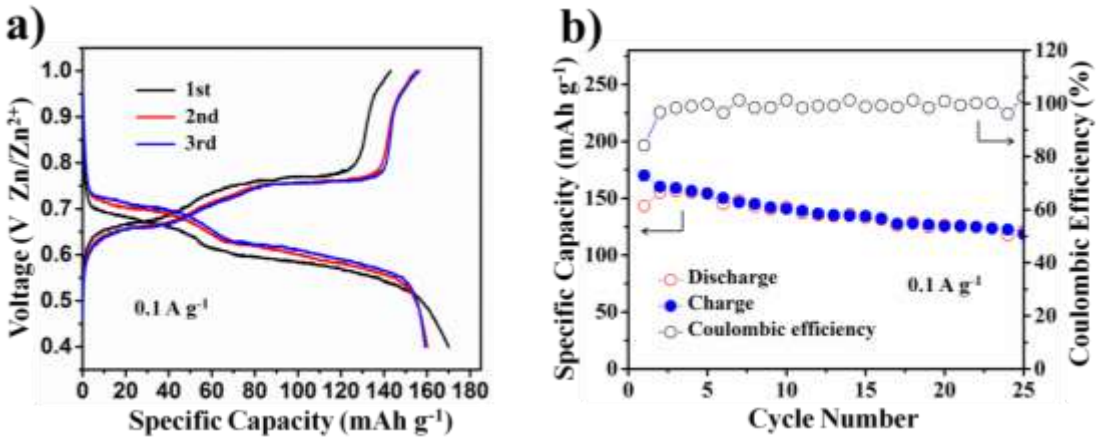

Figure S3. a) The charge and discharge curves of VS_2 at 0.1 A g^{-1}, b) Cyclic properties

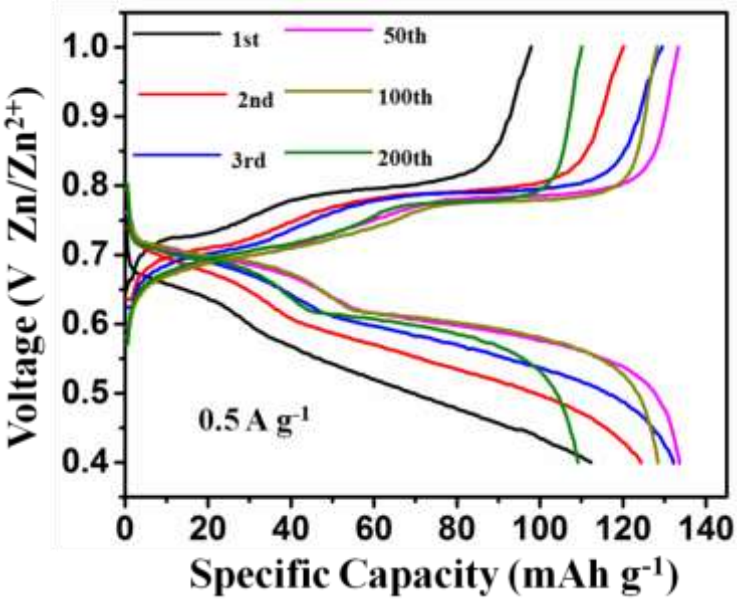

Figure S4. The charge and discharge curves of VS_2 of different cycles at a current density of 0.5 A g^{-1}.

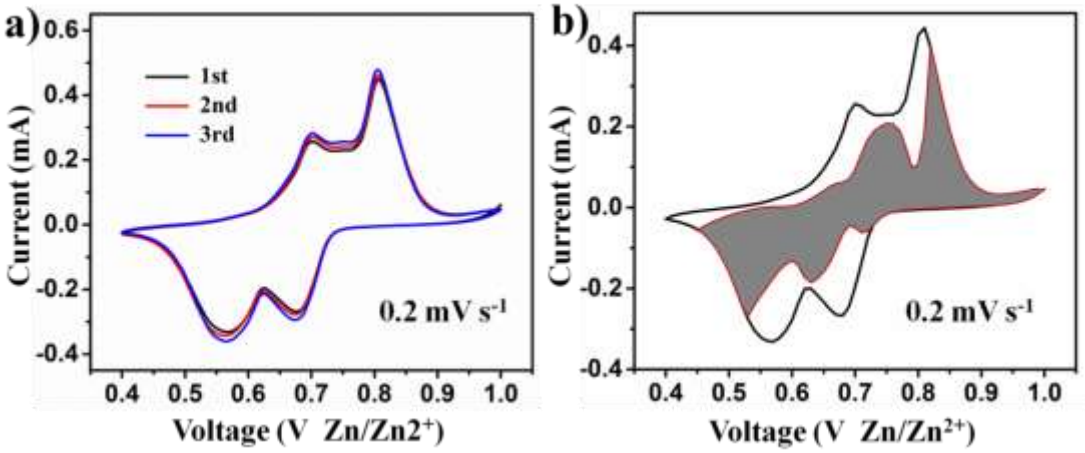

Figure S5. a) The CV curves of VS_2 at a scan rate of 0.1 mV/s, b) The contribution ratio of the capacitive capacities and diffusion-limited capacities at 0.1 mV/s.

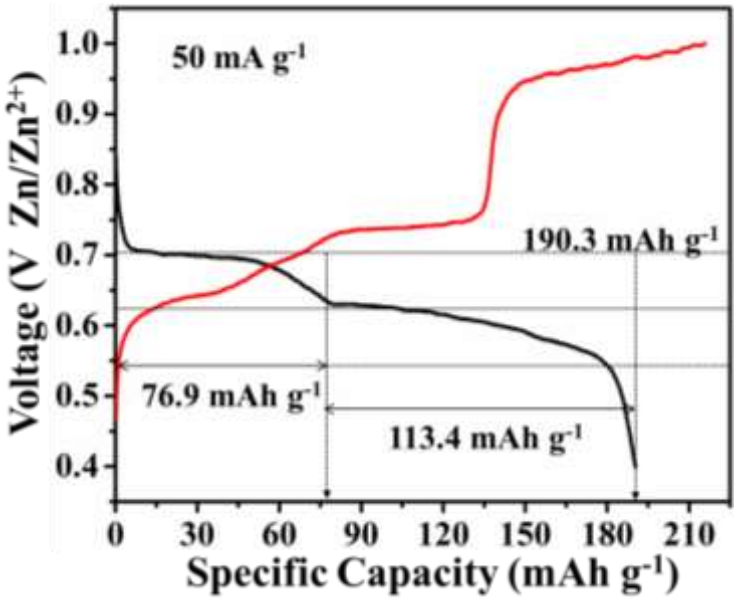

Figure S6. The charge and discharge curves of VS_2 at 0.05 A g^{-1}.

In the first step: $VS_2 + xZn^{2+} + 2xe^- \leftrightarrow Zn_xVS$ ($x = 0.09$)

In the second step: $Zn_xVS_2 + yZn^{2+} + 2ye^- \leftrightarrow Zn_{x+y}VS_2$ ($y = 0.14$)

x and *y* are calculated based on the following equations:
($F = N_A*e = 96500$ C/mol, $N_A = 6.02\times10^{23}$, 1 A h = 1 A$\times$3600s = 3600 C, $C_0 = 26.8$ nm/M)