Supporting Information

Highly Conductive VO_2 treated with hydrogen for supercapacitors

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The specific surface area of as-grounded and H_2 treated VO_2 powder was 8.64 ±1.60 m^2/g and 4.97 ±1.22 m^2/g respectively obtained by nitrogen physisorption at cryogenic temperatures using the Brunauer-Emmett-Teller (BET) method.

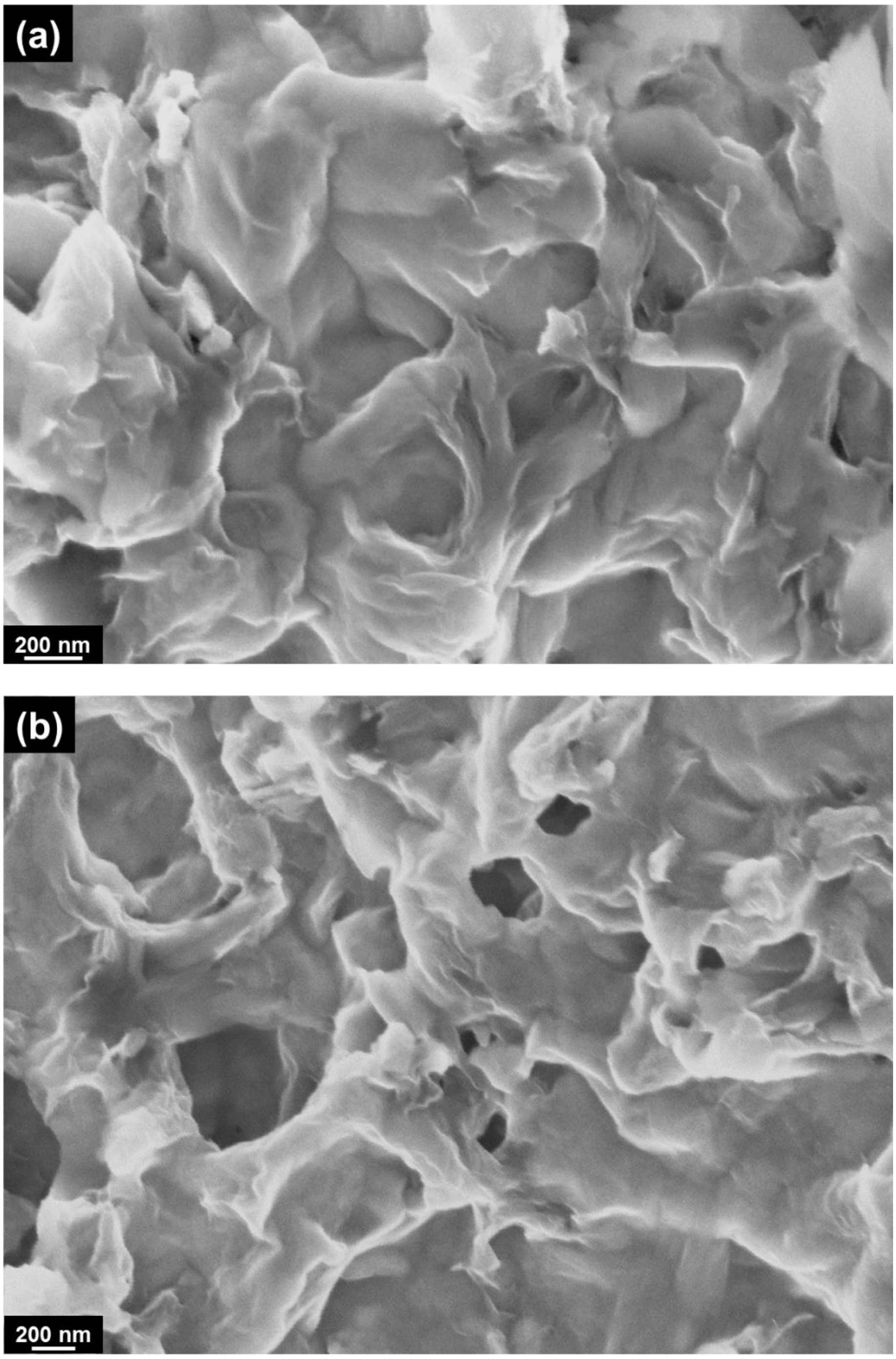


Figure S1 SEM images of commercial VO_2 powder before grinding.

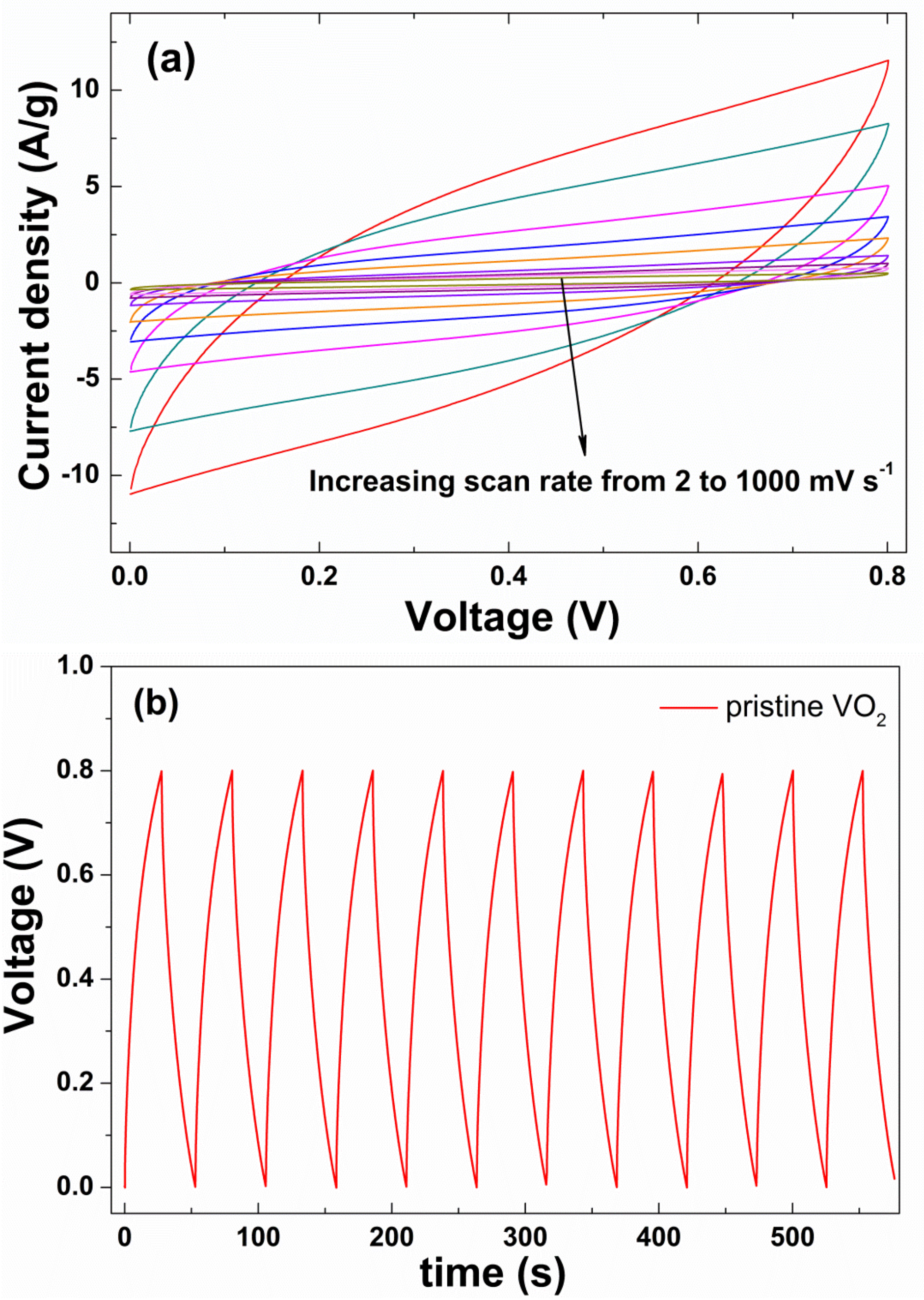


Figure S2 (a) Cyclic voltammograms of pristine VO_2 over a voltage window between 0 and 0.8 V in 1 M Na_2SO_4 aqueous electrolyte at different scan rates from 2 to 1000 mV s^{-1}; (b) galvanostatic charge/discharge behavior of pristine VO_2 with an applied constant current density of 1 A g^{-1} in the potential window between 0 and 0.8 V.

The specific discharge capacitance and specific energy density according to the charge/discharge curves of pristine VO_2 was calculated to be 76 F g^{-1} and 1.8 W h kg^{-1} respectively after the capacitance behavior became stable.

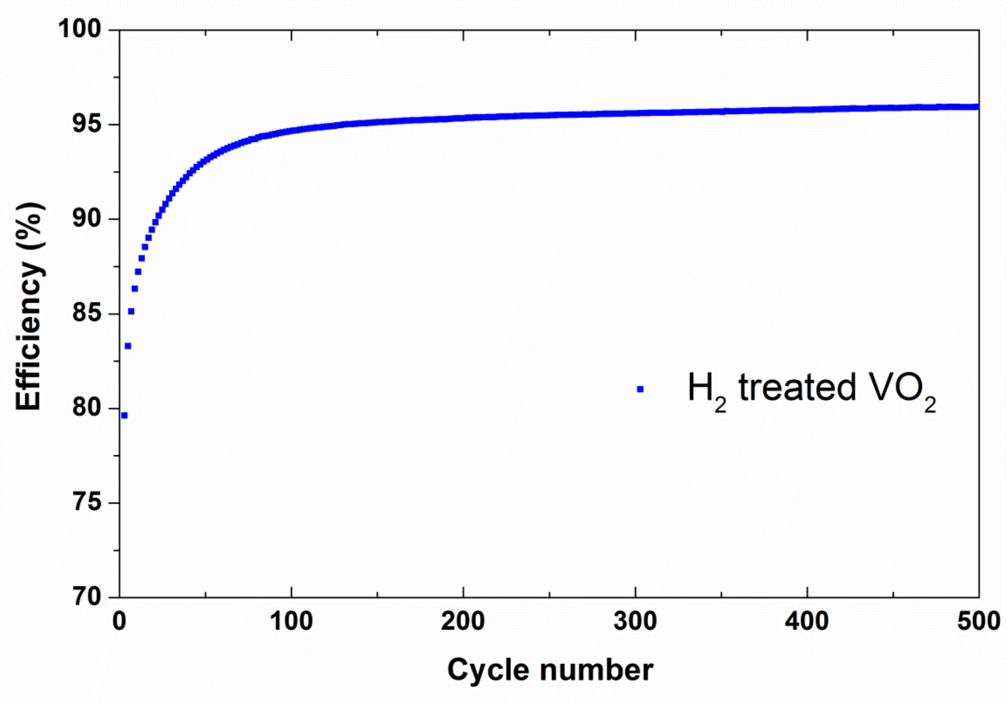
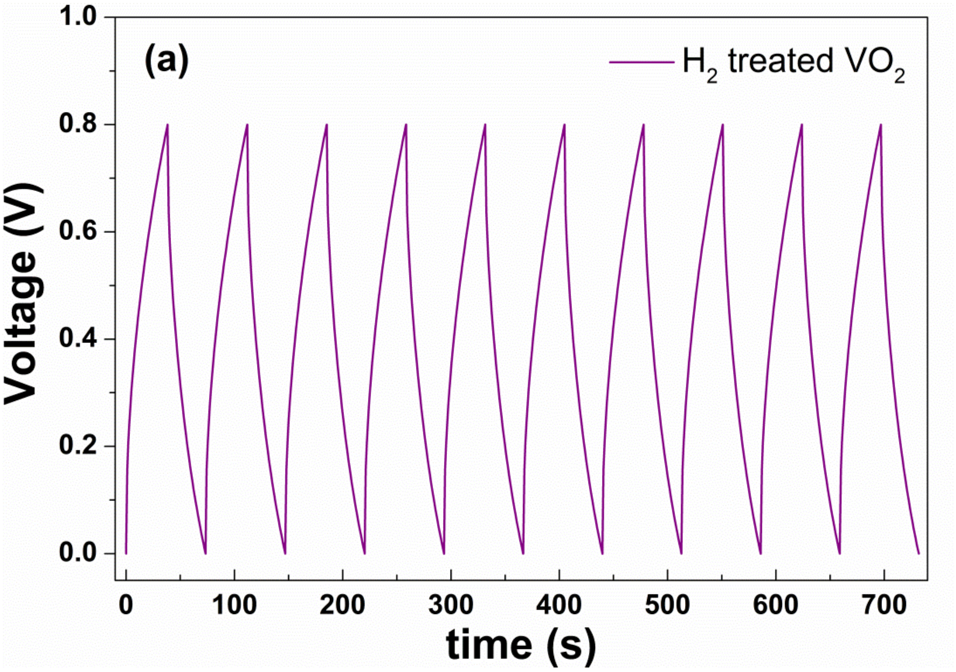


Figure S3 The efficiency of the supercapacitor based on H_2 treated VO_2 as a function of cycle number.



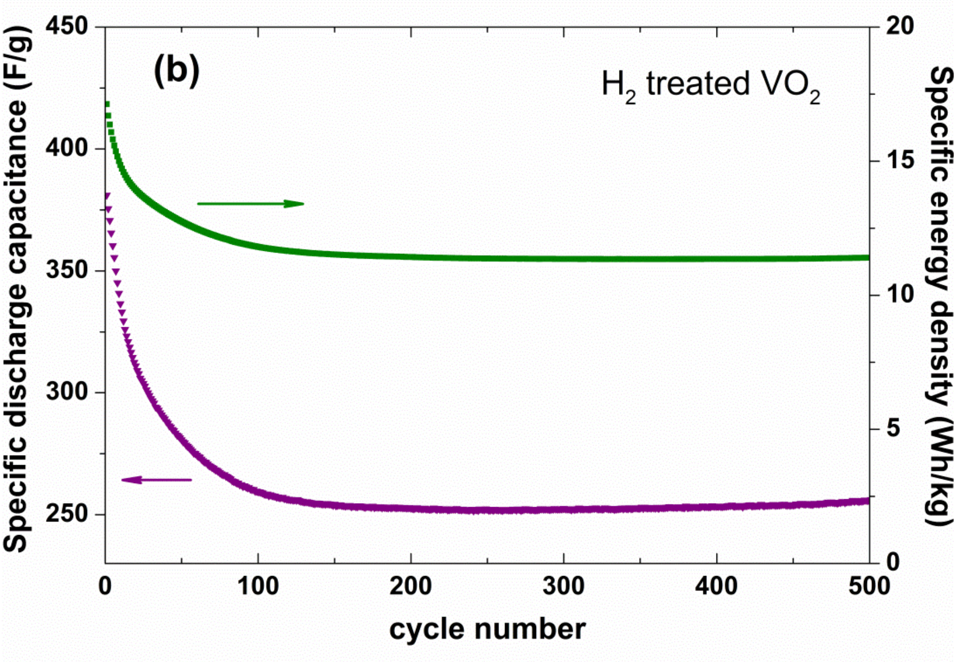


Figure S4 (a) Galvanostatic charge/discharge behavior of H_2 treated VO_2 with an applied constant current density of 5 A g^{-1} in the potential window between 0 and 0.8 V; (b) Specific discharge capacitance and specific energy density of H_2 treated VO_2 as a function of cycle number.

The specific discharge capacitance and specific energy density was calculated to be around 250 F g^{-1} and 12 W h kg^{-1} respectively after stabilization at around 200 cycles.

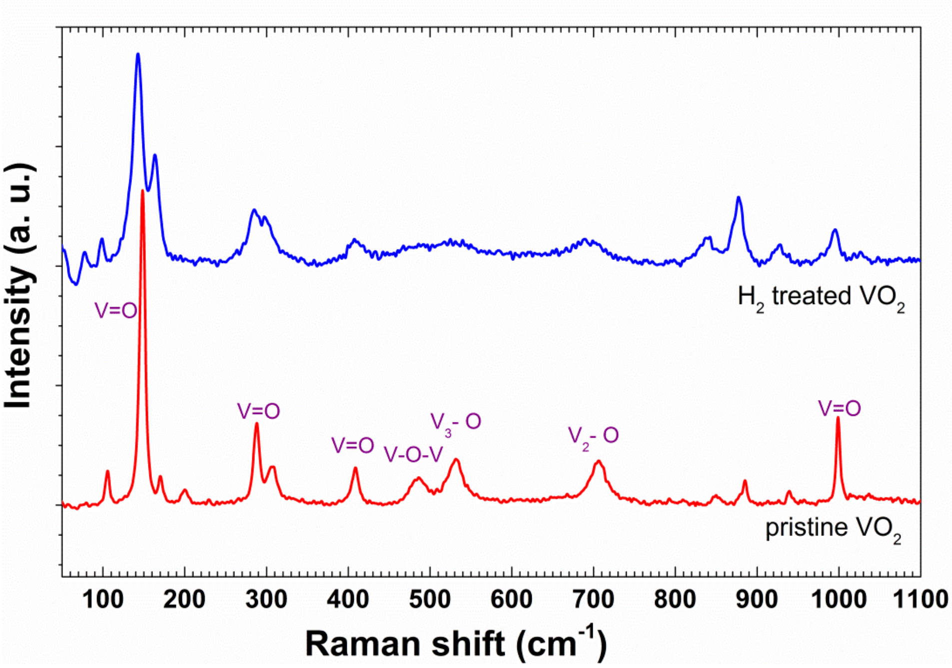


Figure S5 Raman spectra of the pristine VO_2 and H_2 treated VO_2.

Dispersive Raman spectroscopy (SENTERRA, Bruker Co.) was used to examine the structural changes between pristine VO_2 and H_2 treated VO_2 with an excitation laser of 532 nm and integration time of 5 s at the power of 2 mW.

The existence of triply coordinated V_3-O stretching mode resulting from edge-shared oxygens of three pyramids indicates slight oxidization have happened to the pristine VO_2. Doubly coordinated V_2-O bonds at 710 cm^{-1} result from corner-shared oxygens of two pyramids. The peak located at 485 cm^{-1} is attributed to the bending vibration of the bridging V-O-V. The apparent decrease in intensity of the peaks of V=O, V_3-O, and V_2-O bonds is observed in H_2 treated VO_2, which suggests the H_2 treatment might reduce the vanadium valence states. Moreover, the H_2 treated VO_2 shows a broad band from 450 to 800 cm^{-1}, which may be assigned to the partially structural distortion caused by hydrogen intercalation.

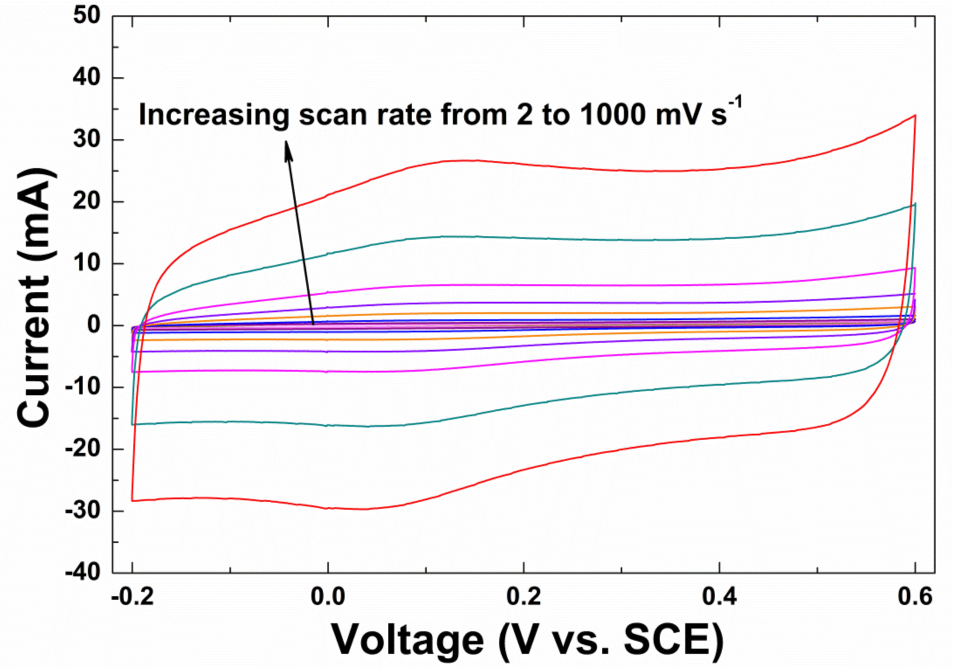


Figure S6 Cyclic voltammograms of H_2 treated VO_2 as working electrode in a three-electrode configuration with SCE as reference electrode and Pt wire as the counter electrode over a voltage window between -0.2 and 0.6 V in 1 M Na_2SO_4 aqueous electrolyte at different scan rates from 2 to 1000 mV s^{-1}.

The anodic and cathodic peaks were observed at around 0.04 V and 0.13 V vs. SCE respectively.