

Supporting information:

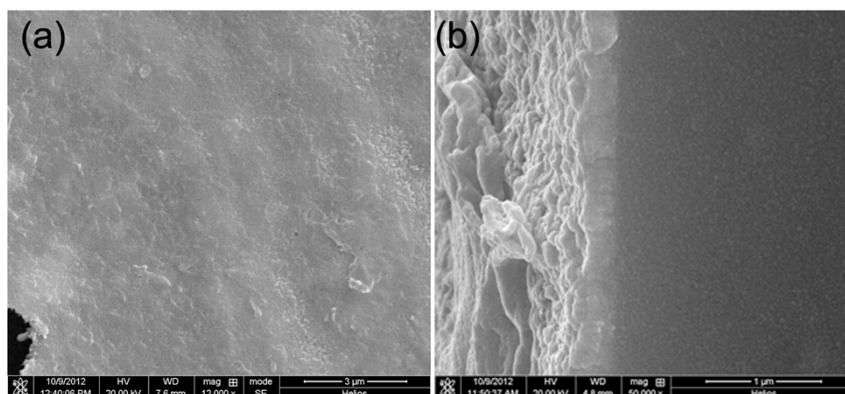


Fig. S1. Top-view and cross-section SEM images of the dense film.

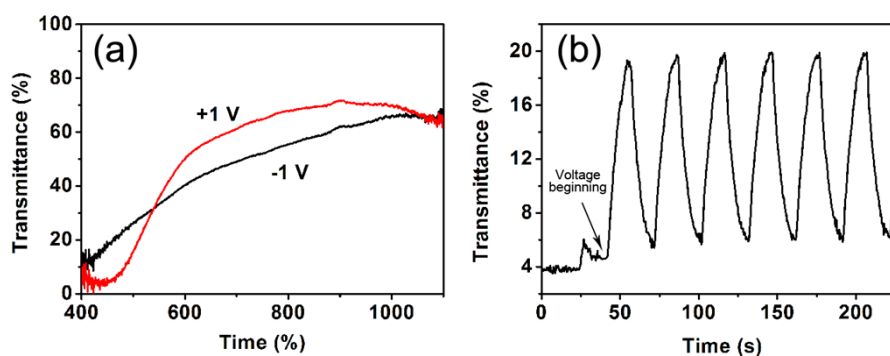


Fig. S2. (a) (b) Transmittance contrast and transmittance-time switching response curve of the dense film.

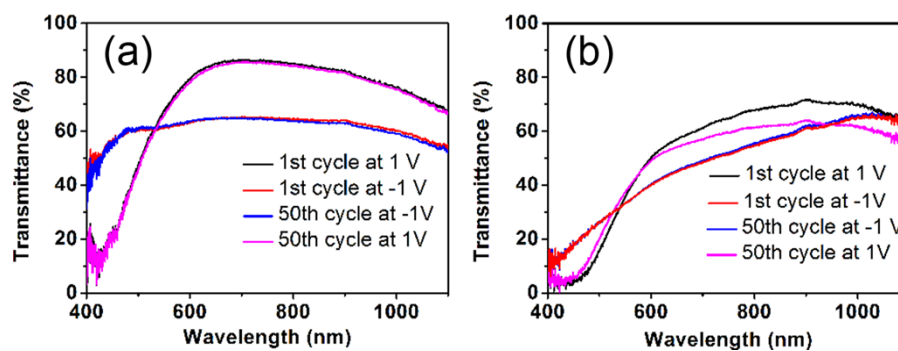
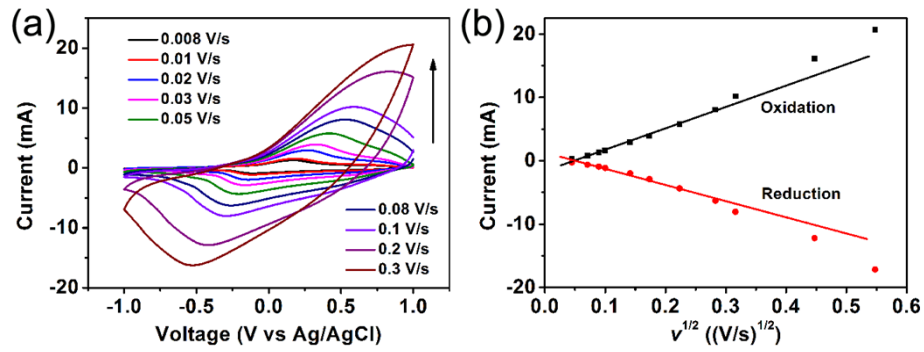
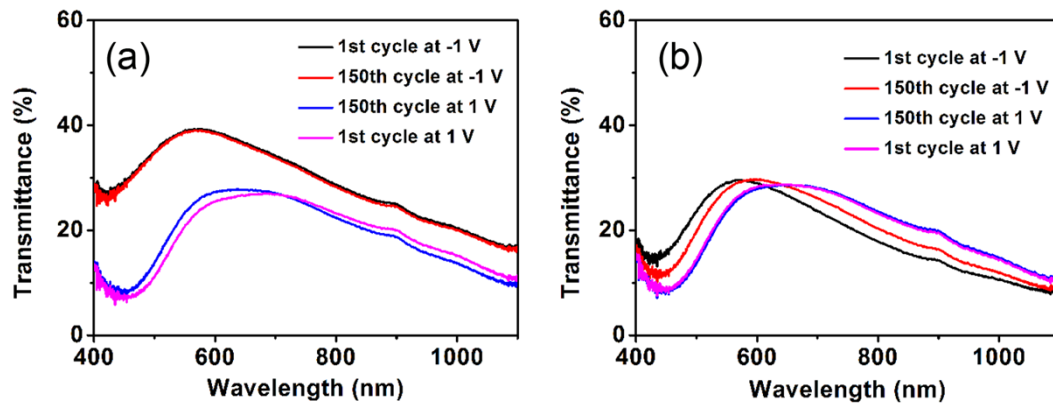


Fig. S3. Transmittance modulations and cycling performance of the 3DOM film (a) and dense film (b) for 50 cycles.



**Fig. S4.** (a) CV curves of the dense film at various scan rates. (b) Fitting plots between peak current  $i$  and square root of scan rate  $v^{1/2}$ .



**Fig. S5.** Transmittance modulation of the electrochromic device fabricated with the 3DOM vanadium oxide film (a) and dense vanadium oxide film (b) at 1<sup>st</sup> cycle and 150<sup>th</sup> cycle.