Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A

A Rechargeable Electrochromic Energy Storage Device Enabling Effective Energy Recovery

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Content of Supporting Information

1. Top-view SEM images of LTO and NiO films

As shown in Figure S1, both $Li_4Ti_5O_{12}$ (LTO) and NiO films demonstrated loose and porous structures owing to the stacking of nanoparticles, which provided dense nanochannels for fast insertion and extraction of lithium ions.

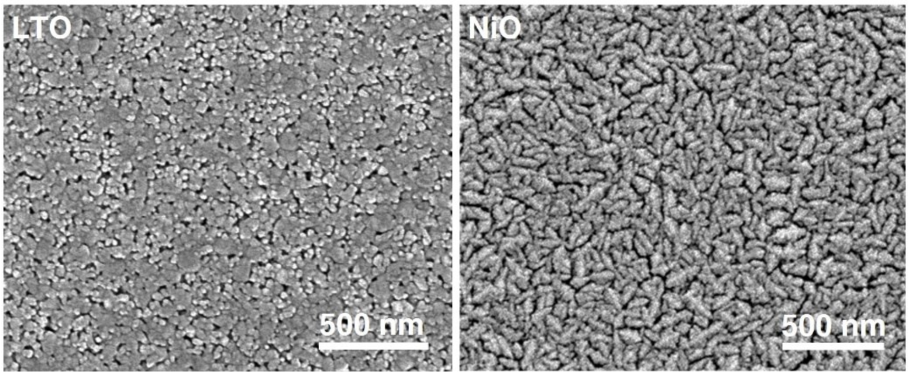

Figure S1. Top-view SEM images of $Li_4Ti_5O_{12}$ (LTO) and NiO films on the conductive substrates.

2. The GCD profiles of LTO electrode

Figure S2 depicts the galvanostatic charge/discharge profiles at different current densities between -1.8 V and -0.5 V and the corresponding in situ transmittance responses at 550 nm. Here, we defined the optical modulation rate (ΔT) as the maximum transmittance difference between the colored and bleached states. The ΔT reached 55% at a current density of 0.1 mA cm^{-2} with GCD measured, indicating a good electrochromic performance of the LTO/FTO/glass electrode.

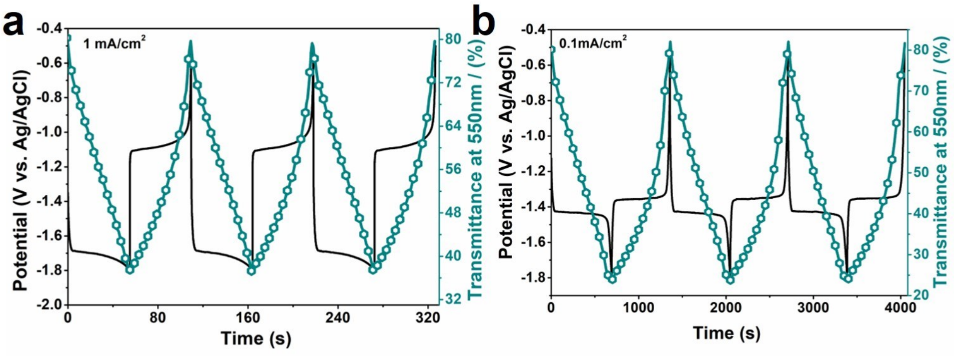

Figure S2. GCD profiles (black line) at current densities of 1 mA cm^{-2} and 0.1 mA cm^{-2} and the corresponding in situ transmittance responses (green line) for $Li_4Ti_5O_{12}$ thin films.

3. The CV curves of anode electrodes at different scan rates

Figure S3 presented the CV curves of anode NiO under different scan rate in Li^+ containing electrolytes. The CV behaviors demonstrated two pairs of typical redox peaks at positive potentials. The peak positions almost maintained constant with increasing scan rate, suggesting a high efficiency of redox reaction.[1]

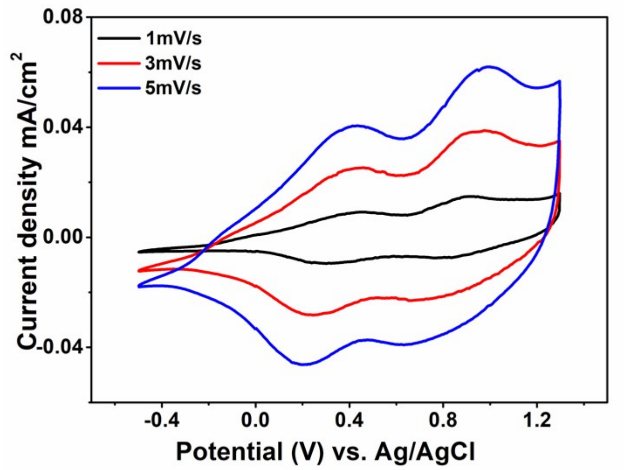

Figure S3. CV curves of NiO electrodes at different scan rates.

4. Transmittance spectra of NiO electrodes at colored and bleached states

As shown in Figure S4, the reduced NiO film had a high transmittance while the oxidized one exhibited dark brown with a low transmittance.

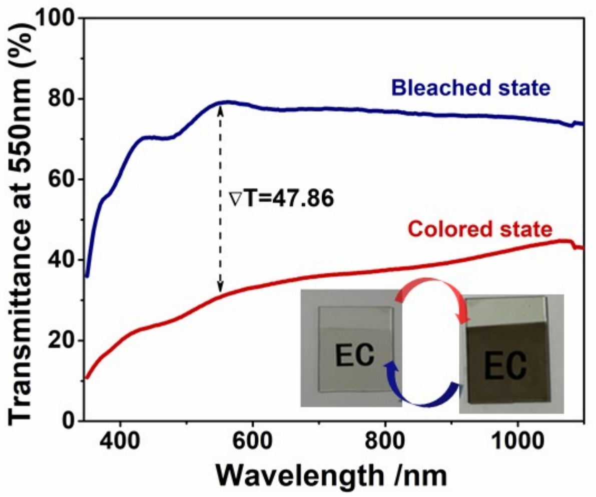

Figure S4. Transmittance spectra of NiO electrode at oxidized and reduced states from 350 to 1100 nm.

5. Response times of the EESD coloring and bleaching

In EC devices, the response time is defined as the 90% of the time duration between totally colored and bleached states. Here, the response times for coloration and bleaching were determined to be ~7.4 s and ~6.5 s (Figure S5), which were extremely short compared with other comparable systems (typically over 10 s).[2,3]

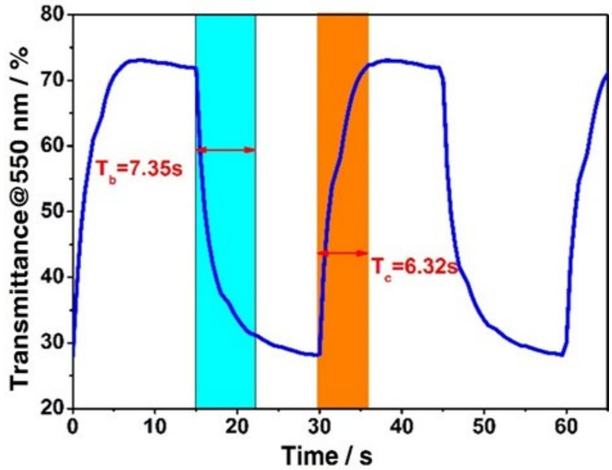

Figure S5. Response times of the EESD coloring and bleaching.

6. Photograph of the prototype device of an EESD window

Finally, we developed a 10 cm ×10 cm EESD window to demonstrate its feasibility for effective energy recovery. In spite of a large area, the EESD window still demonstrated uniform color distributions at bleached and colored states (Figure S6).

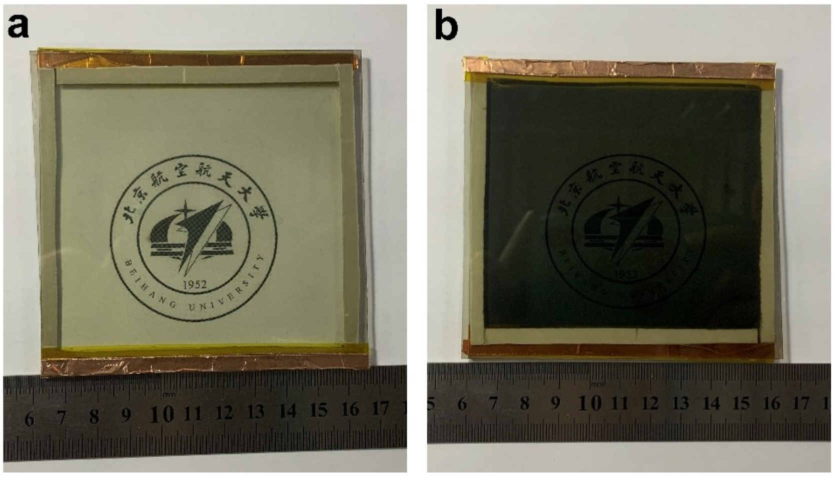

Figure S6. The prototype device of an EESD window at bleached (a) and colored (b) states.

7. References

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