

Supplementary Information

Ultrahigh cycling stability and wide infrared modulation of electrochromic devices based on electrodeposited triphenylamine cross-linked polyaniline derivatives

Yulin Liu¹, Hengzhi Zhang¹, Shengwei Tang¹, Rongzong Zheng^{1,2}, Chunyang Jia^{1*}

¹ National Key Laboratory of Electronic Thin Films and Integrated Devices, National Engineering Research Center of Electromagnetic Radiation Control Materials, School of Integrated Circuit Science and Engineering, University of Electronic Science and Technology of China, Chengdu 611731, P. R. China

² College of Materials and Metallurgy, Guizhou University, Guiyang 550025, P. R. China

* Corresponding author: E-mail: cyjia@uestc.edu.cn

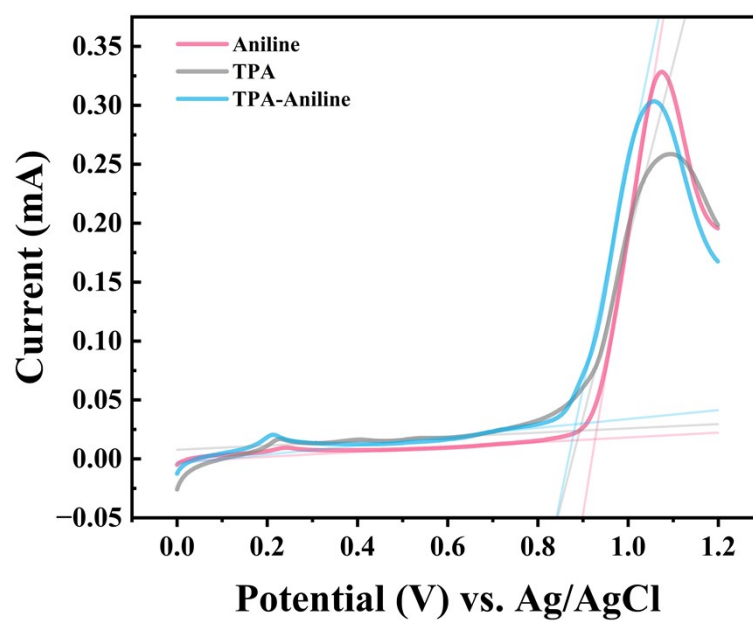


Figure S1. LSV curves of aniline (0.1 M), TPA (1 mM) and TPA (1 mM)-aniline (0.1 M) in ethanol (water:ethanol=1:4, V/V)-H₂SO₄ solutions.

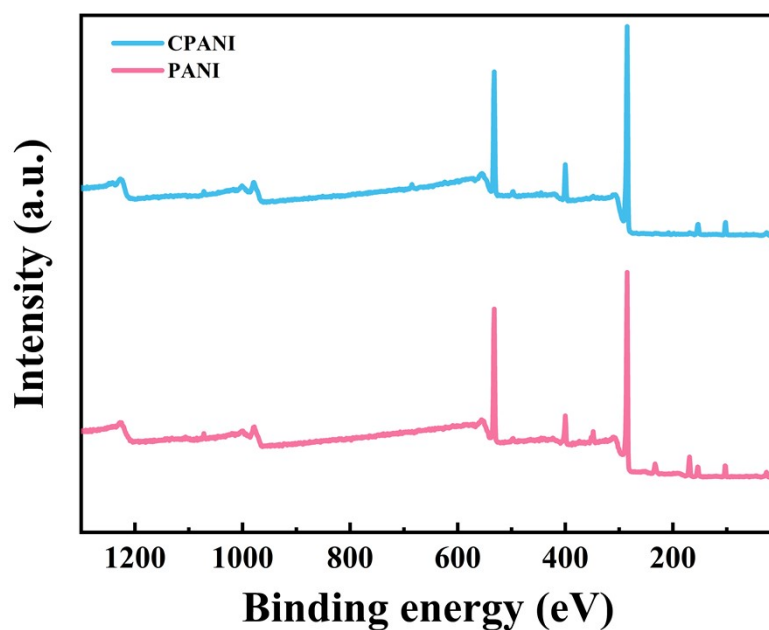


Figure S2. XPS spectra of CPANI and pure PANI.

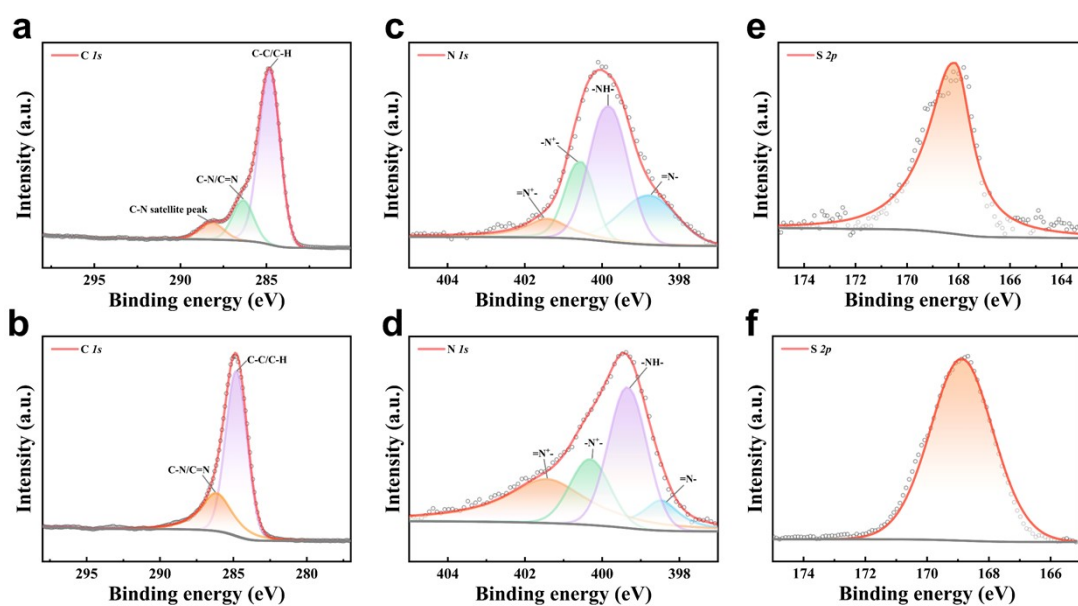


Figure S3. High-resolution XPS spectra. C 1s core level spectra of (a) CPANI and (b) pure PANI. N 1s core level spectra of (c) CPANI and (d) pure PANI. S 2p core level spectra of (e) CPANI and (f) pure PANI.

Table S1. XPS elemental ratio results for CPANI and pure PANI films

Film	C1s	N1s	[C]/[N]
CPANI	90.4	9.61	9.41
PANI	89.32	10.68	8.36

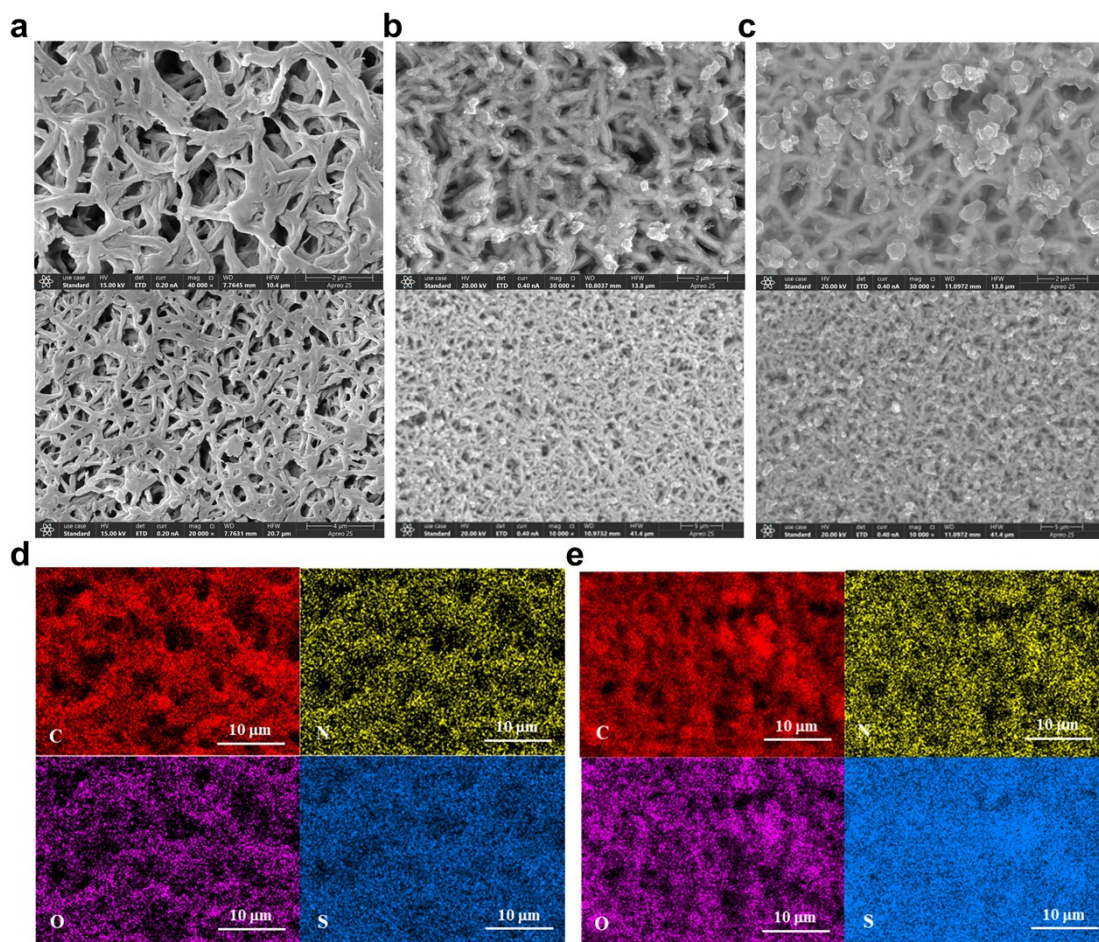


Figure S4. SEM images of the (a) porous Au electrode, (b) CPANI electrode and (c) pure PANI electrode. The EDS mapping of the (d) CPANI electrode and (e) pure PANI electrode.

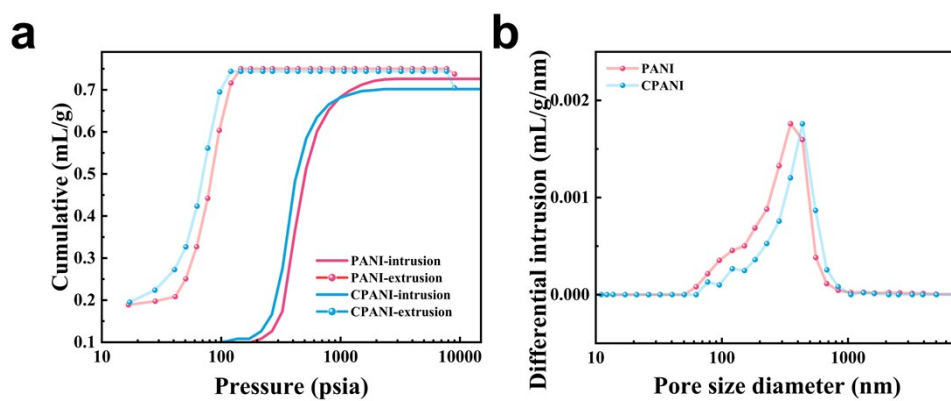


Figure S5. MIP test curves. (a) The Cumulative-pressure curves. (b) The pore size distribution curves.

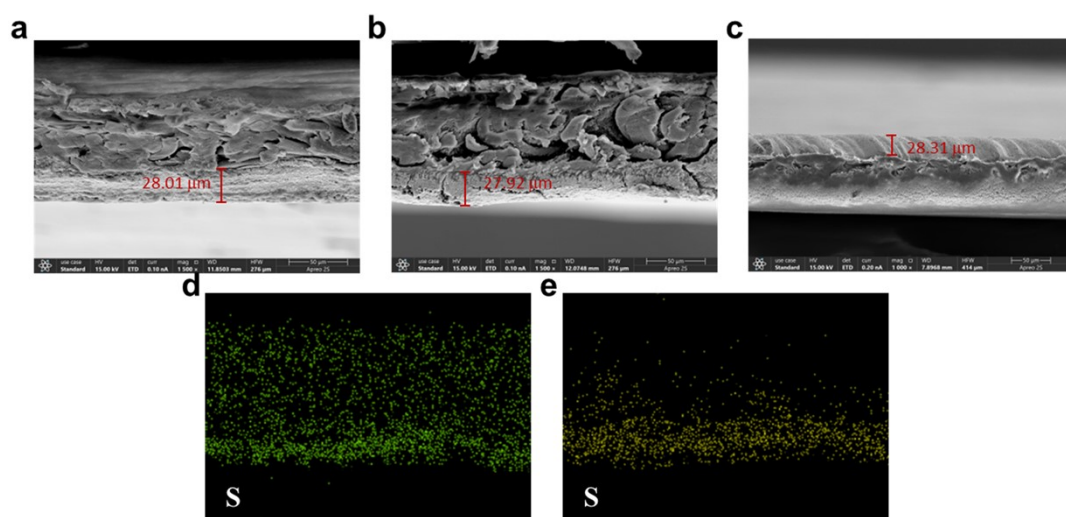


Figure S6. SEM images of the cross-section of the (a) CPANI electrode, (b) pure PANI electrode and (c) porous Au electrode. The EDS cross-section mapping of the S element of the (d) CPANI electrode and (e) pure PANI electrode.

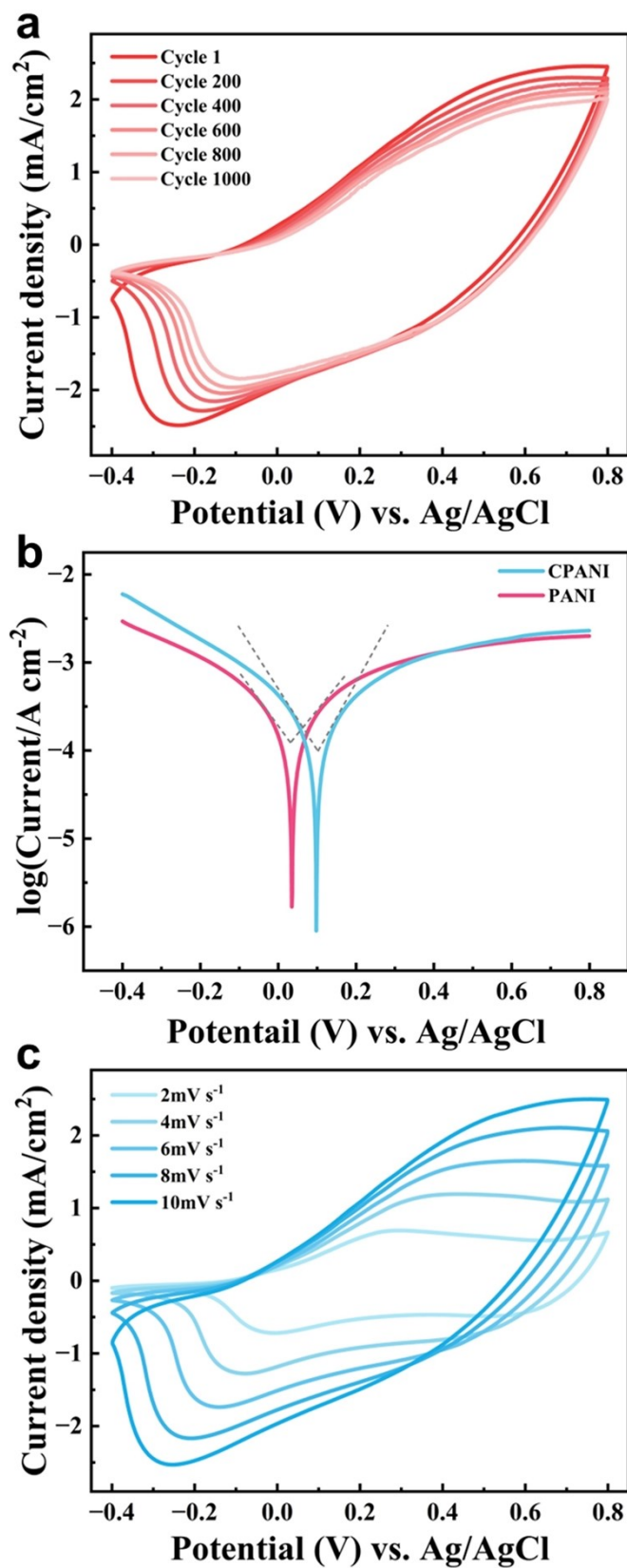


Figure S7. (a) The CV curves at 10 mV s^{-1} of different numbers of cycles of the pure PANI electrode. (b) The Tafel plots. (c) The CV curves at different scan rates of the pure PANI electrode.

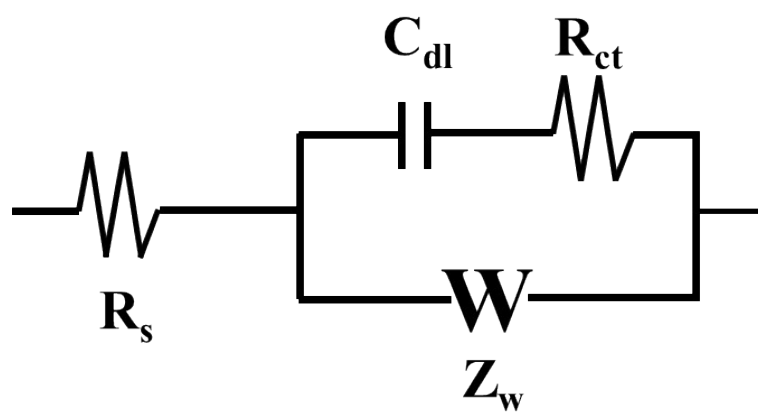


Figure S8. The fitted equivalent circuits of Nyquist plots of the C-RECD and P-RECD.

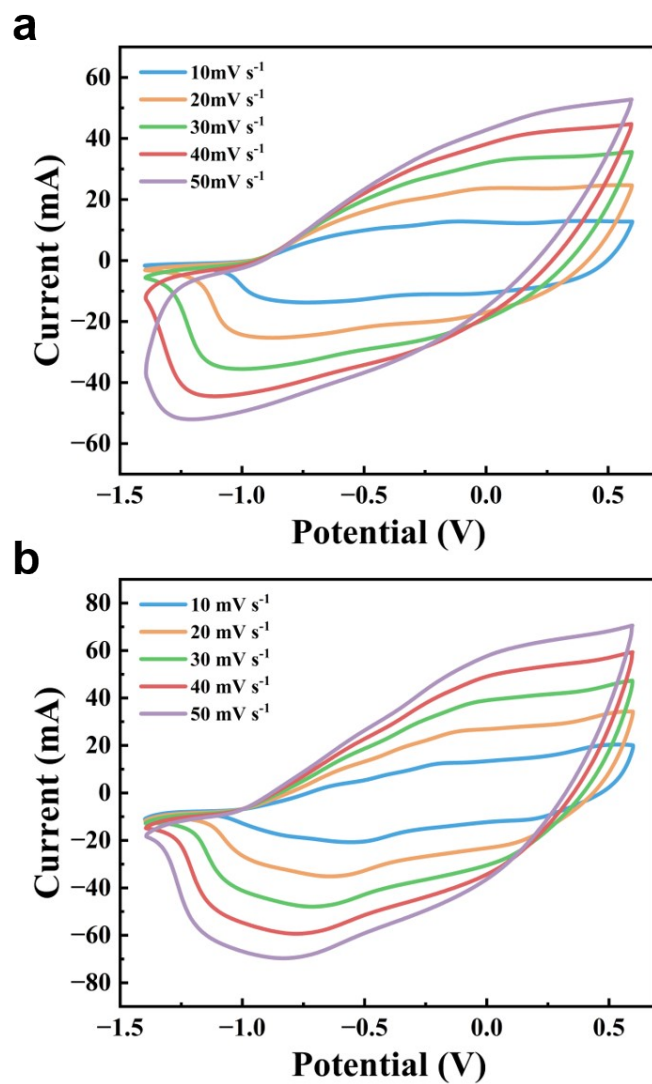


Figure S9. The CV curves at different scan rates of the (a) C-RECD and (b) P-RECD.

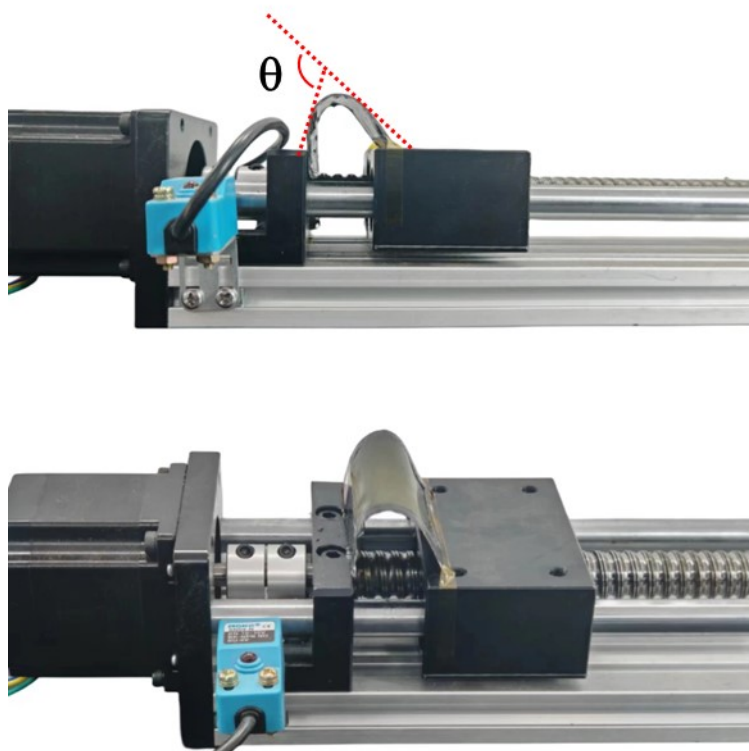


Figure S10. Schematic diagram of the bending angle test.

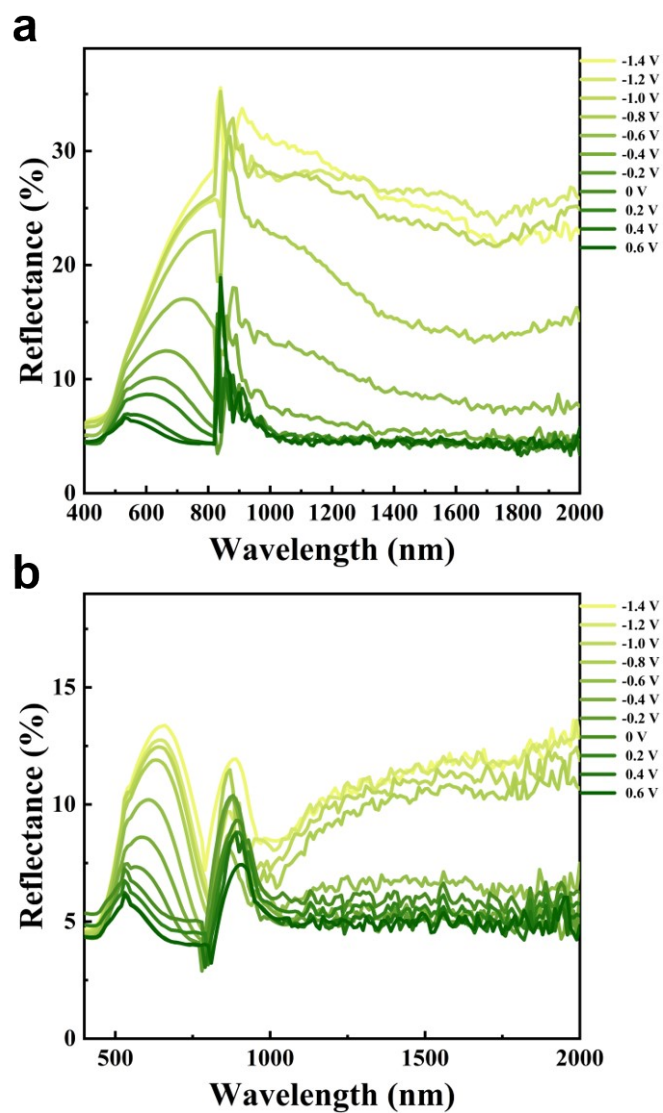


Figure S11. Vis-NIR reflectance curves of the (a) C-RECD and (b) P-RECD.

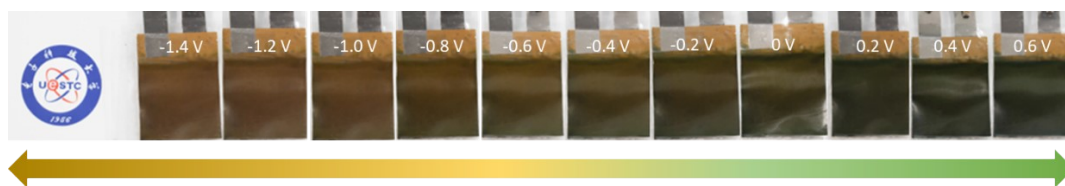


Figure S12. Visible light band electrochromic properties of the C-RECD.

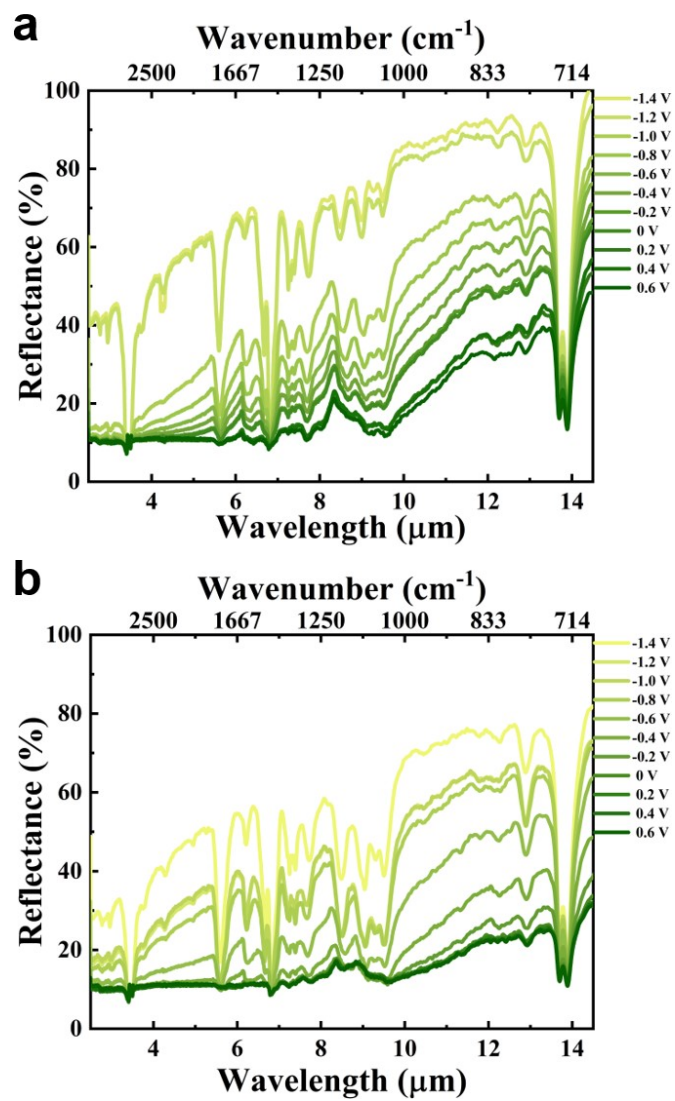


Figure S13. Thermal-infrared reflectance curves of the (a) C-RECD and (b) P-RECD.

Table S2. The average thermal-infrared emissivity of RECDs at different voltages and bands

Voltages	CPANI-RECD			PANI-RECD		
	3-5 μm	8-14 μm	2.5-15 μm	3-5 μm	8-14 μm	2.5-15 μm
-1.4 V	0.47	0.19	0.24	0.58	0.38	0.41
-1.2 V	0.48	0.22	0.26	0.72	0.50	0.53
-1.0 V	0.78	0.42	0.47	0.71	0.51	0.53
-0.8 V	0.83	0.49	0.54	0.76	0.53	0.56
-0.6 V	0.86	0.55	0.59	0.85	0.64	0.66
-0.4 V	0.87	0.60	0.63	0.88	0.75	0.76
-0.2 V	0.88	0.64	0.67	0.89	0.80	0.81
0.0 V	0.89	0.65	0.68	0.89	0.82	0.82
0.2 V	0.89	0.73	0.75	0.89	0.82	0.83
0.4 V	0.89	0.74	0.75	0.89	0.82	0.83
0.6 V	0.89	0.76	0.77	0.89	0.82	0.83

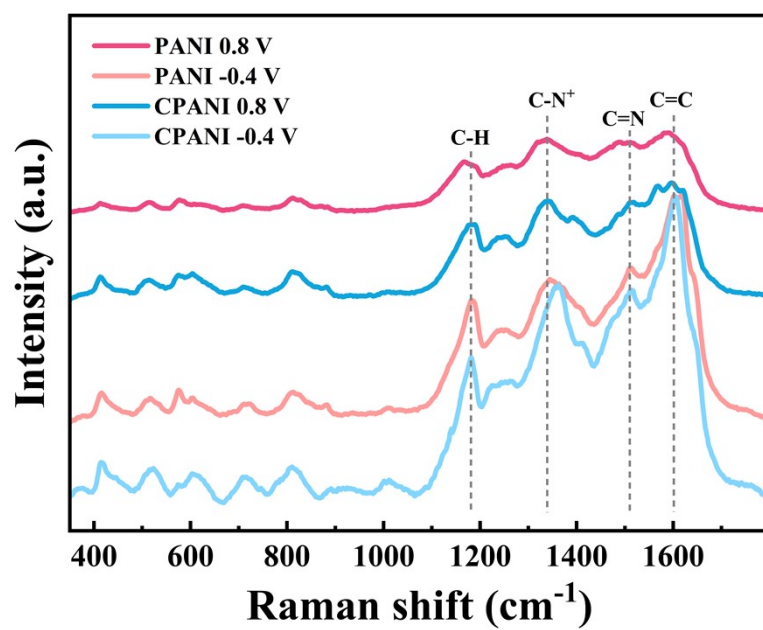


Figure S14 *In situ* Raman spectra of the CPANI and pure PANI electrode at 0.8 V and -0.4 V.

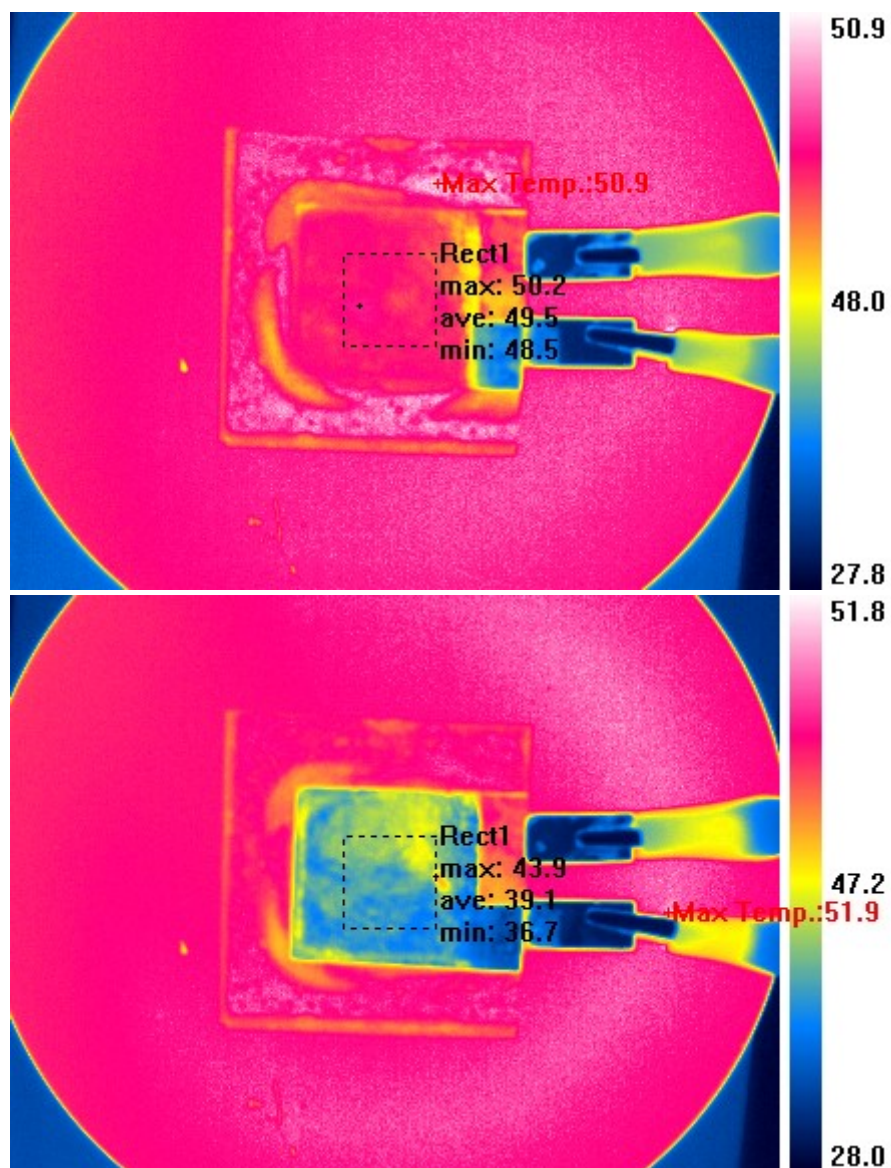


Figure S15. Thermal-infrared images of the P-RECD on a hot plate of 50 °C.

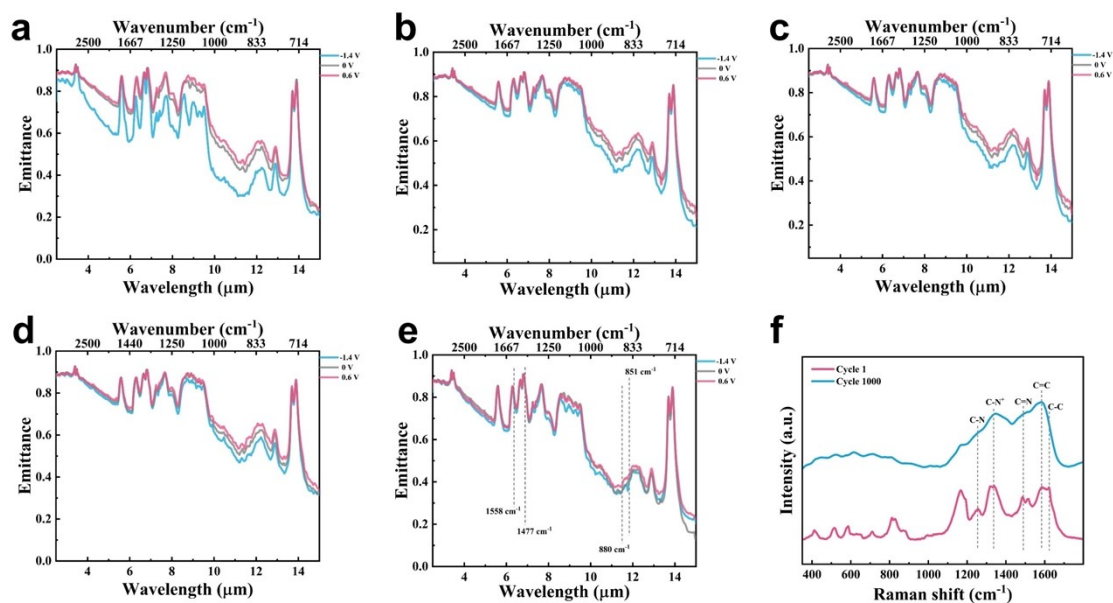


Figure S16. Emissive spectra of the P-RECD after (a) 2,000 cycles, (b) 4,000 cycles, (c) 6,000 cycles, (d) 8,000 cycles, and (e) 1,0000 cycles. (f) Raman spectra of the pure PANI electrode before and after the CV scans of 1,000 cycles.