Supporting Information

In-situ measurement of breathing strain and mechanical degradation in organic electrochromic polymers

Xiaokang Wang[†], Luize Scalco de Vasconcelos[†], Ke Chen[‡], Kuluni Perera[‡], Jianguo Mei[‡,],*

Kejie Zhao[†,]*

[†]School of Mechanical Engineering, Purdue University, West Lafayette, IN 47907, United States
[‡]Department of Chemistry, Purdue University, West Lafayette, IN 47907, United States

*Corresponding authors: jgmei@purdue.edu (J. Mei), kjzhao@purdue.edu (K. Zhao)
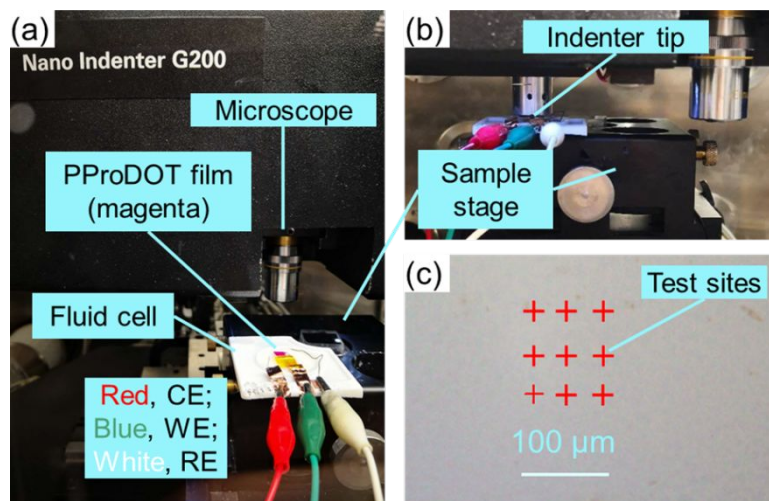
Figure S1. The experimental setup of the in-situ measurement of mechanical strain in PProDOT. (a) Fluid cell with the PProDOT film, Ag/AgCl reference electrode, and Pt counter electrode mounted on the sample stage. The copper wire connecting the ITO substrate is covered with electrochemically inert epoxy. (b) Indenter tip on the sample. (c) nine indentation sites under the microscope.
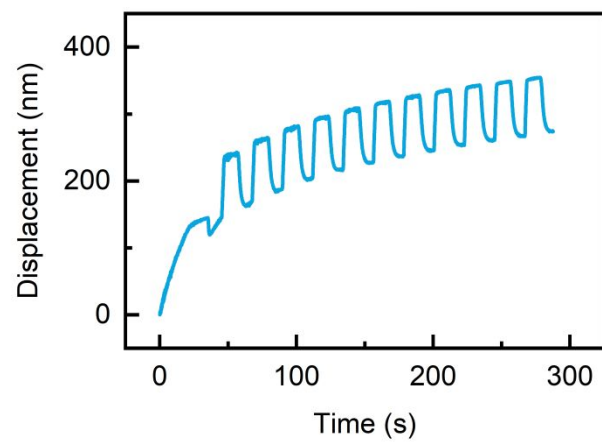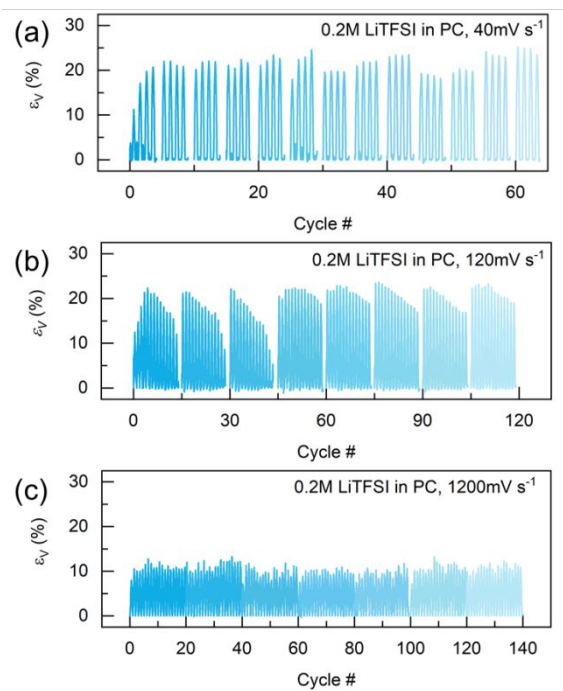
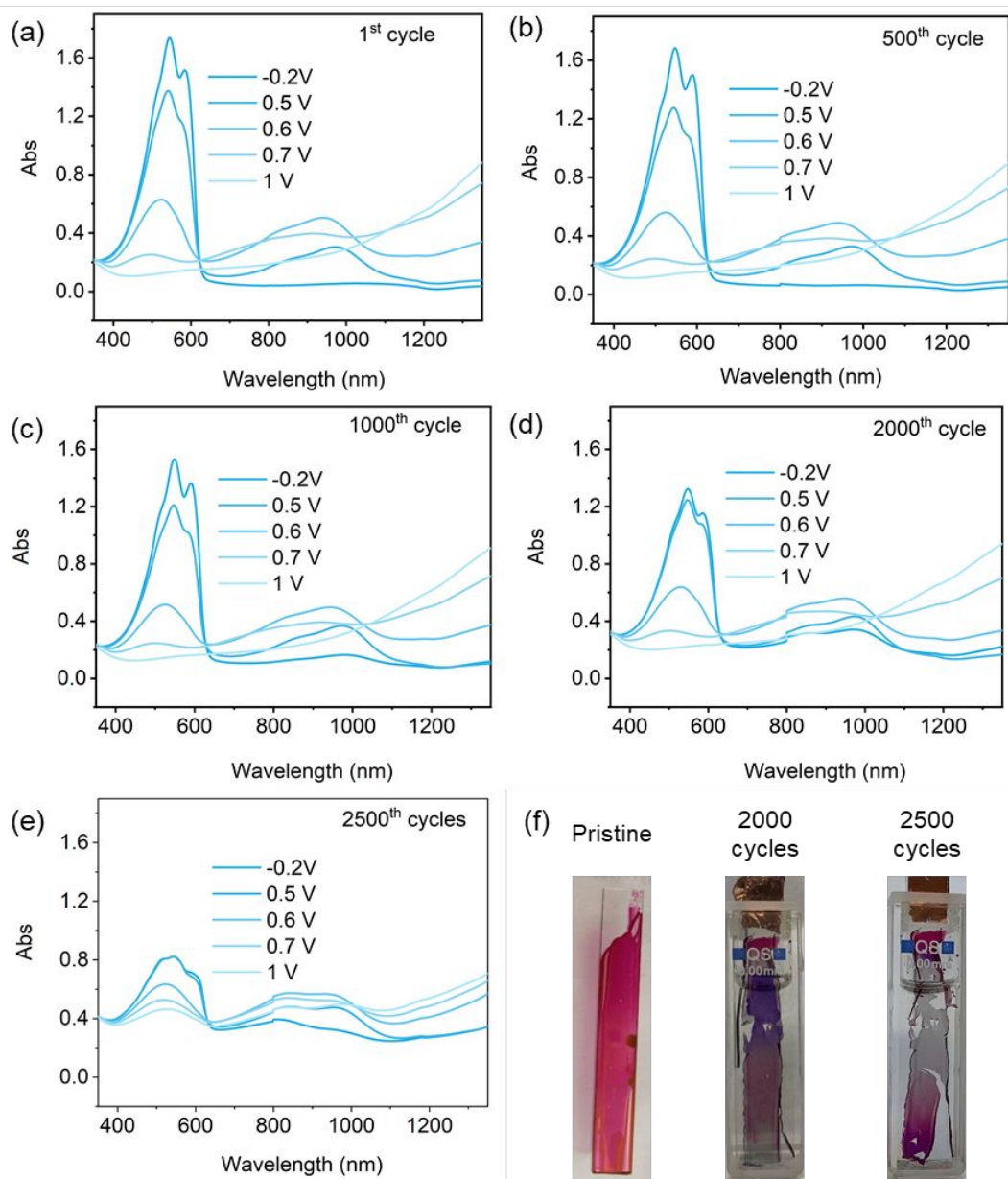**Figure S2.** Tip displacement during the redox reaction.
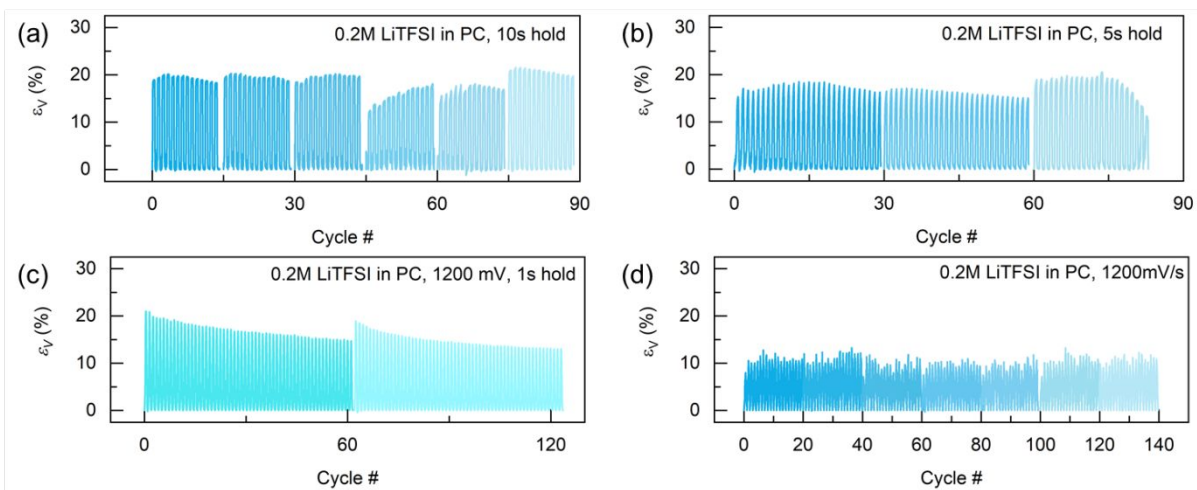
Figure S3. Breathing strain of the PProDOT film for different hold times at the peak voltage.

(a) 10 s, (b) 5 s, (c) 1 s, and (d) 0 s.

Figure S4. Breathing strain of the PProDOT film for different scan rates. (a) 40 mV s^{-1}, (b) 120 mV s^{-1}, and (c) 1200 mV s^{-1}.

Figure S5. Absorbance spectra of PProDOT film at the (a) 1st cycle, (b) 500th cycle, (c) 1000th cycle, (d) 2000th cycle, (e) 2500th cycle, and (f) the film morphologies.

<p align="center">**Table S1**. Color efficiency of the PProDOT film</p>

Cycle #	Transmittance, colored state T_c	Transmittance, bleached state T_b	Optical density change ΔOD	Charge density, q (mC cm^{-2})	Coloration efficiency* η (cm^{2}C^{-1})
1	1.98	73.79	1.55	3.38	459
500	2.41	72.23	1.46	2.86	510
1000	6.36	70.42	1.02	2.6	392
2000	13.62	61.90	0.64	2.05	312
2500 (site 1)	16.89	43.96	0.4	0.96	416
2500 (site 2)	25.39	26.95	0.02	1.07	18.7

$^*\eta = \frac{\Delta \text{OD}}{q} \; where \; \Delta \text{OD} = \log_{10}\left(\frac{T_b}{T_c}\right)$