Supporting information

Intrinsically Multi-Color Device Based on Dynamic Cooperation of Molecular Switches and Metal Ions

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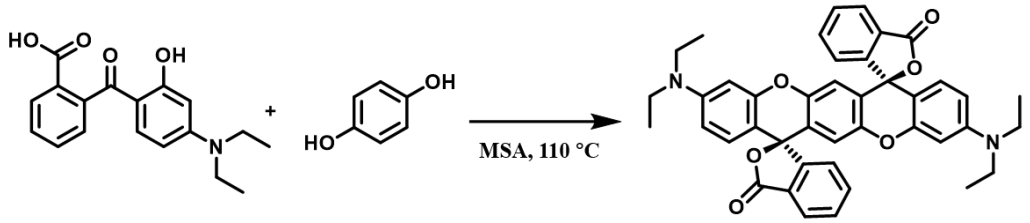

Fig. S1. The synthetic route for cis-ABPX.

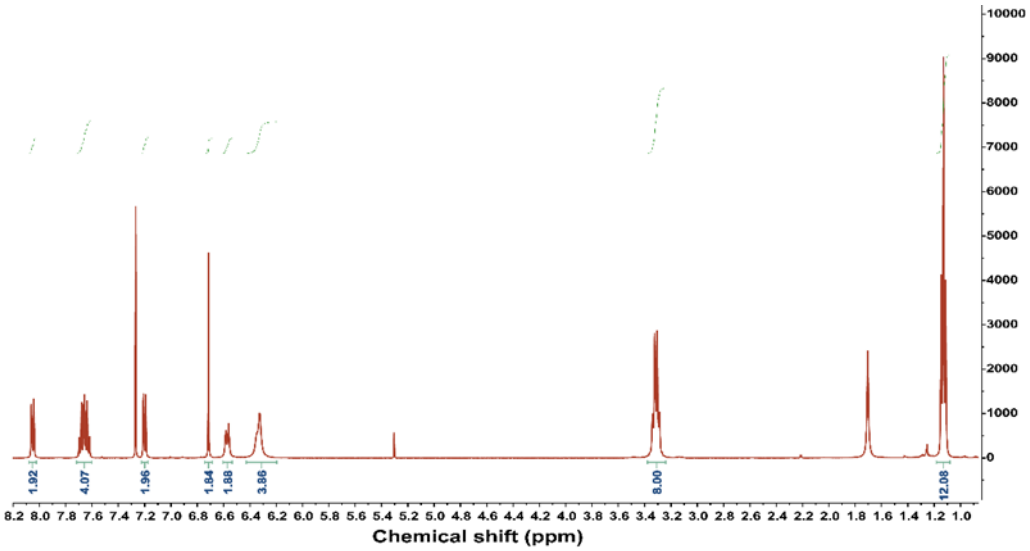

Fig. S2. The ^{1}H NMR spectra of cis-ABPX in $CDCl_3$.

cis-ABPX: ^{1}H NMR (400 MHz, Chloroform-d) δ 8.05 (dt, J = 7.2, 1.0 Hz, 2H), 7.72–7.60 (m, 4H), 7.20 (dt, J = 7.7, 0.9 Hz, 2H), 6.71 (s, 2H), 6.57 (d, J = 8.6 Hz, 2H), 6.33 (s, 4H), 3.31 (q, J = 7.1 Hz, 8H), 1.13 (t, J = 7.0 Hz, 12H).

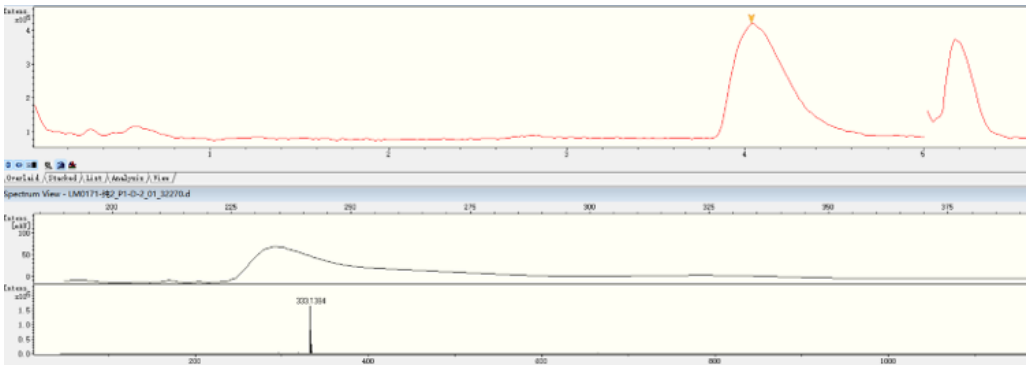

Fig. S3. HRMS spectrum of cis-ABPX.

cis-ABPX: Calcd. For $C_{42}H_{37}N_2O_6$ $[M+2H]^{2+}$: 333.1359. Found: 333.1384.

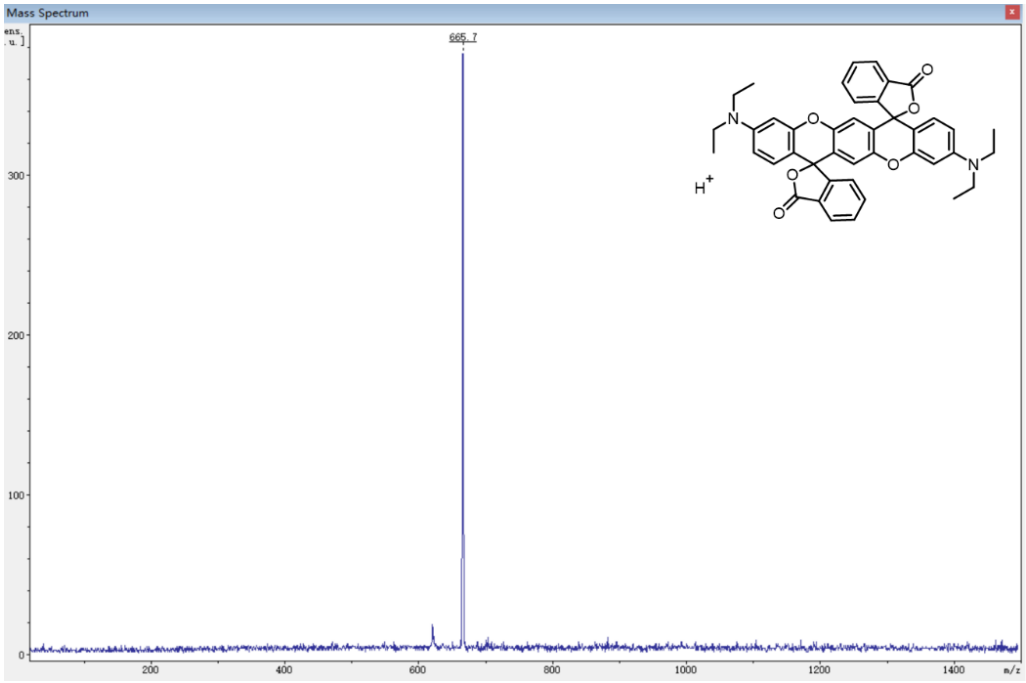

Fig. S4. MALDI-TOF mass spectrometry of cis-ABPX.

cis-ABPX: Calcd. For $C_{42}H_{37}N_2O_6$ $[M+H]^+$: 665.8. Found: 665.7.

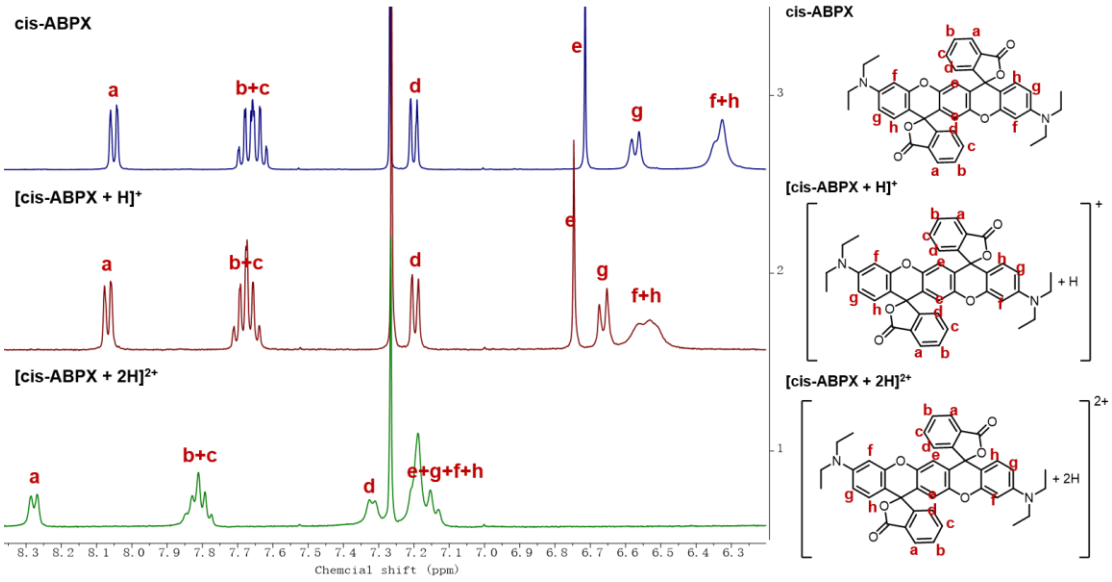

Fig. S5. ^1H NMR spectra of cis-ABPX, $[cis\text{-}ABPX \& H]^+$ and $[cis\text{-}ABPX \& 2H]^{2+}$, TFA was used as proton source, and samples were dissolved in $CDCl_3$.

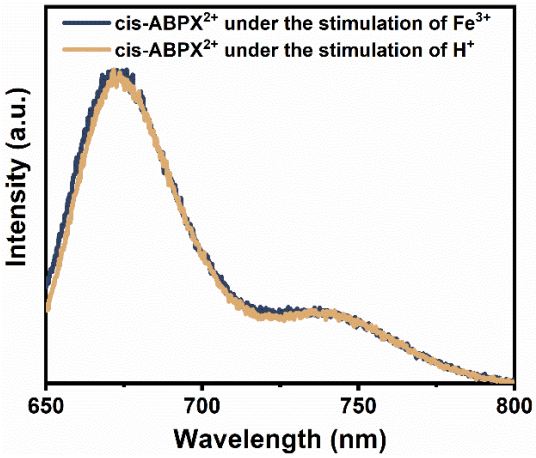

Fig. S6. The fluorescence spectra of cis-ABPX treated with excess Fe^{3+} or H^{+} respectively.

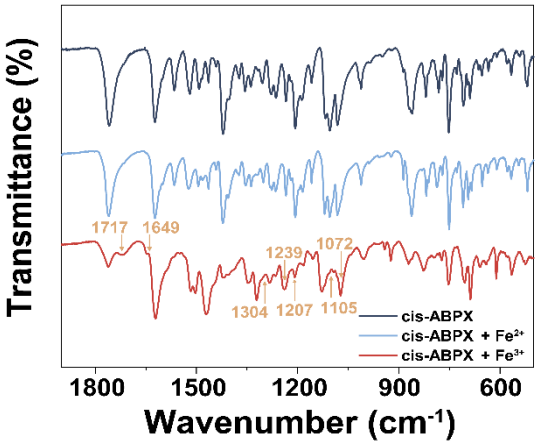

Fig. S7. The IR spectra of cis-ABPX (black curve), cis-ABPX & Fe^{2+} (blue curve) and cis-ABPX & Fe^{3+} (red curve) in the ranges of 400 - 4000 cm^{-1} wave numbers.

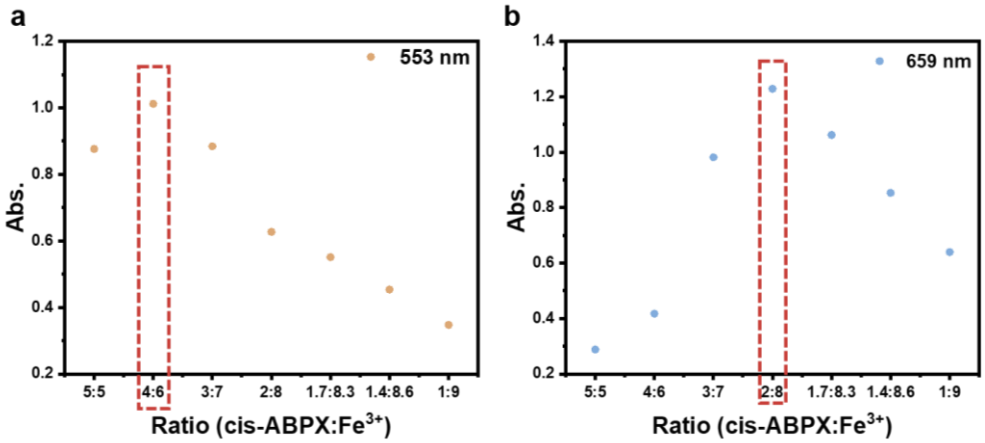

Fig. S8. Jobs plot of cis-ABPX:$FeCl_3$.

To perform this experiment, solution consisted of cis-ABPX and $FeCl_3$ with different ratio had been prepared, and the total concentration of these solution is the same (1.0×10^{-4} mol/L). Then, the absorbance of these solutions at 553 nm (a) and 659 nm (b) had been tested.

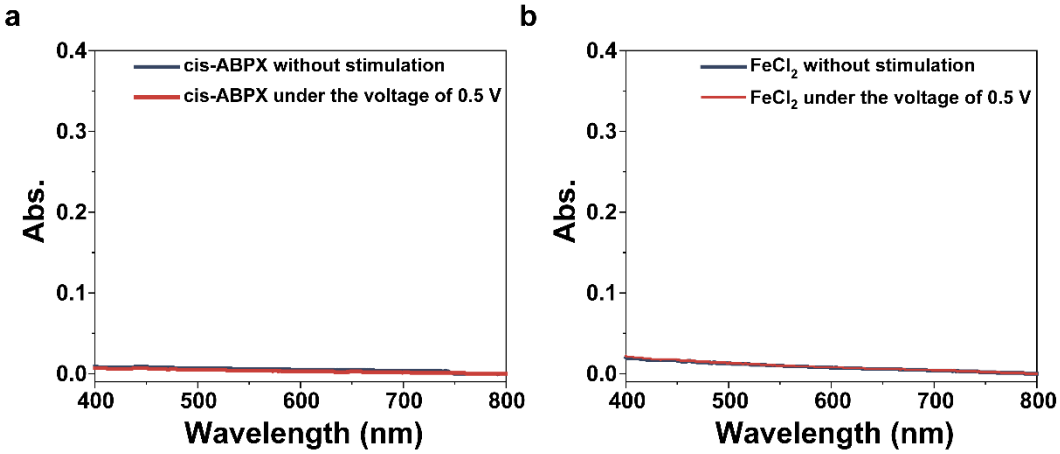

Fig. S9. The absorption spectra of cis-ABPX (a) and $FeCl_2$ (b) without stimulation and under the voltage of 0.5 V. The concentration of cis-ABPX and $FeCl_2$ were 1.0×10^{-4} mol/L in CH_2Cl_2+CH_3CN (v:v=1:1).

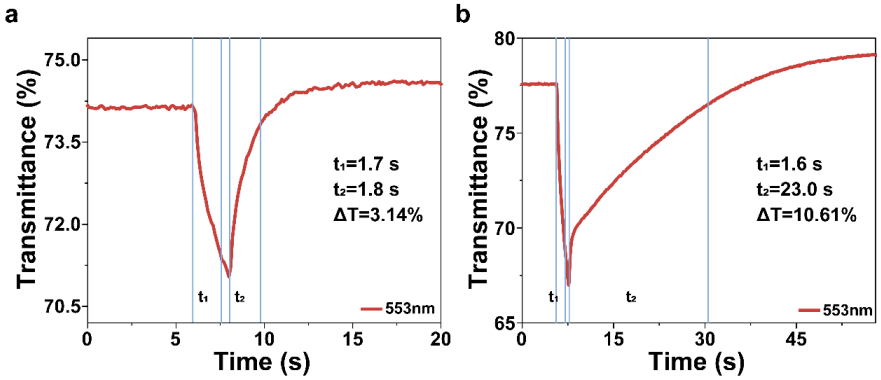

Fig. S10. The transmittance change at 553 nm of the solid-state devices under the voltage of 1.2 V/-0.8 V (a) and 1.8 V/-0.8 V (b) (t_1 and t_2 corresponding to the time that takes to modulate the device transmittance from 0% to 90% of the transmittance change ratio during the coloring or fading process).

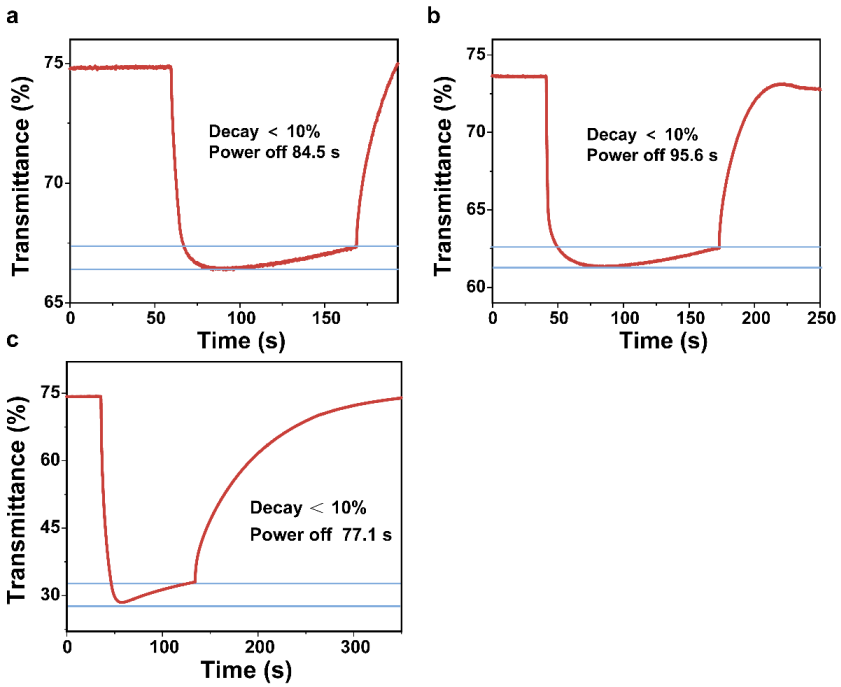

Fig. S11. The transmittance of ECD at 553 nm under stimulation of 1.2 V, power off 84.5 s, -0.8 V (a) and 1.8 V, power off 95.6 s, -1.0 V (b). (c) The transmittance of ECD at 659 nm under stimulation of 1.8 V, power off 77.1 s. -1.0 V.

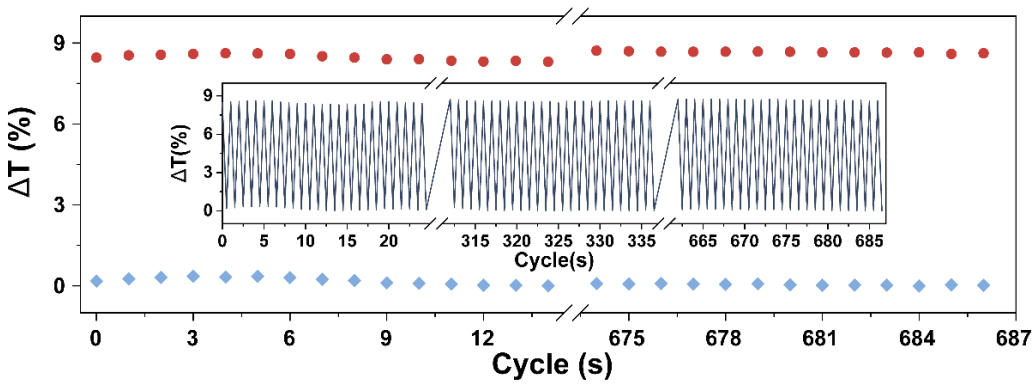

Fig. S12. The ΔT of the ECD at 659 nm under stimulation of 1.7 V/-0.9 V for >600 test cycles, no abnormal changes.

Table S1. The CIE L*a*b* values of the device treated with different voltages.

Stimulation voltage	L^*	a^*	b^*	ΔE*
0 V	40.16	-1.08	0.56	-
0.3 V	52.39	-1.28	-0.06	12 (0 vs. 0.3 V)
0.6V	54.74	0.02	0.02	3 (0.3 vs. 0.6 V)
0.9 V	52.16	2.14	-0.69	3 (0.6 vs. 0.9 V)
1.2 V	48.33	1.84	-1.98	4 (0.9 vs. 1.2 V)
1.5 V	40.00	-3.04	-4.72	10 (1.2 vs. 1.5 V)
1.8 V	30.96	-8.54	-5.91	11 (1.5 vs. 1.8 V)
2.1 V	24.61	-9.59	-6.2	6 (1.8 vs. 2.1 V)
2.4 V	16.41	-9.17	-6.35	8 (2.1 vs. 2.4 V)

*$\Delta E=\sqrt{((\Delta L)^2+(\Delta a)^2+(\Delta b)^2)}$

Where ΔL, Δa, Δb are the brightness difference between the device under the two groups of voltage, the difference between red and green components, the difference between yellow and blue components, and ΔE is the color difference of the device under the two groups of voltage.