Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supplementary information

A bio-inspired electronic synapse using solution processable organic small molecule

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Table S1. Computational energy levels, excitation energies and oscillator strengths, and orbital transition analyses of S_1 for BCPO based on the optimized ground state (S_0) Geometry.

Excited State	state	λ_{cal} (nm)	f (oscillator strength)	assignments
1	S_1	330.15	0.3656	HOMO → LUMO HOMO-1 → LUMO+1
2	S_1	324.17	0.1202	HOMO-1 → LUMO HOMO → LUMO+1

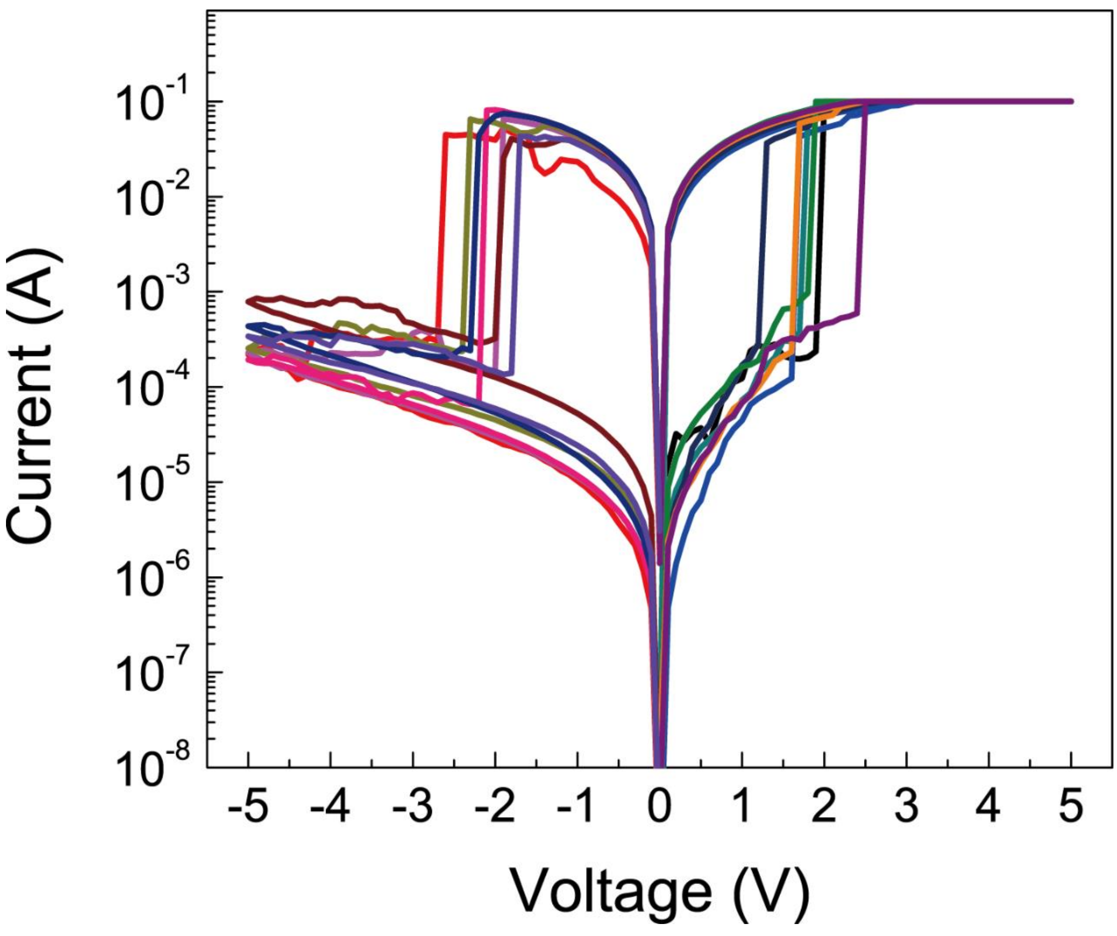

Fig. S1 Typical *I*-*V* tests for device with Au top electrode.

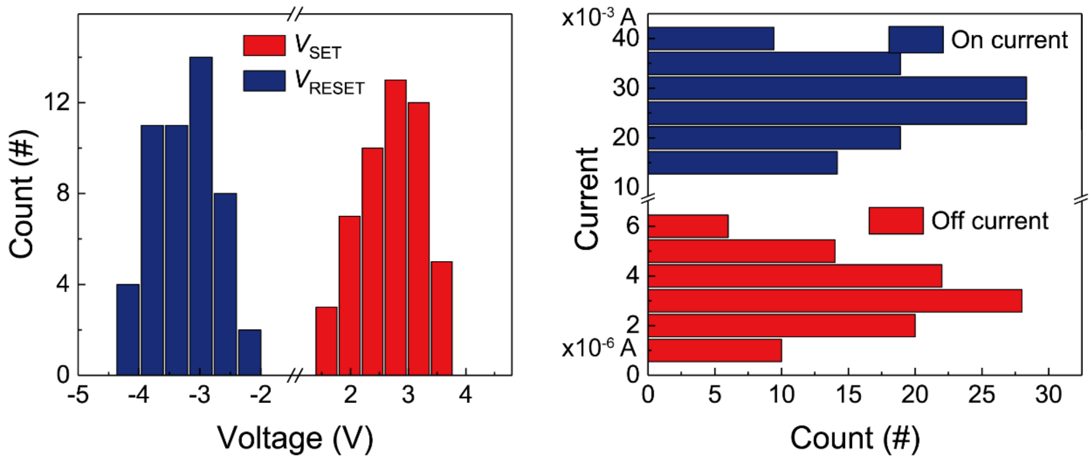

Fig. S2 Histograms of the V_{SET}, V_{RESET}, I_{On} and I_{Off} for 50 samples from 10 fabricated devices.

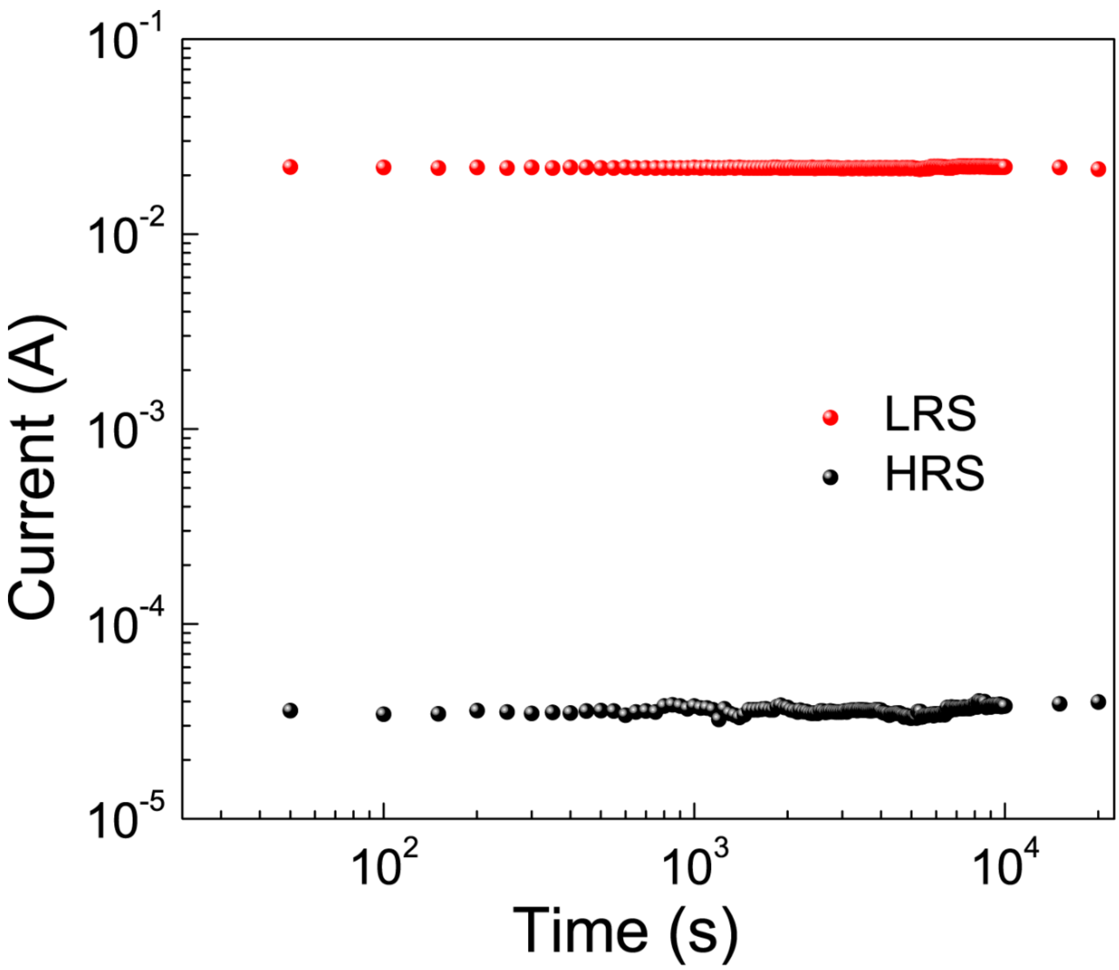

Fig. S3 Retention characteristics for device with Au top electrode.

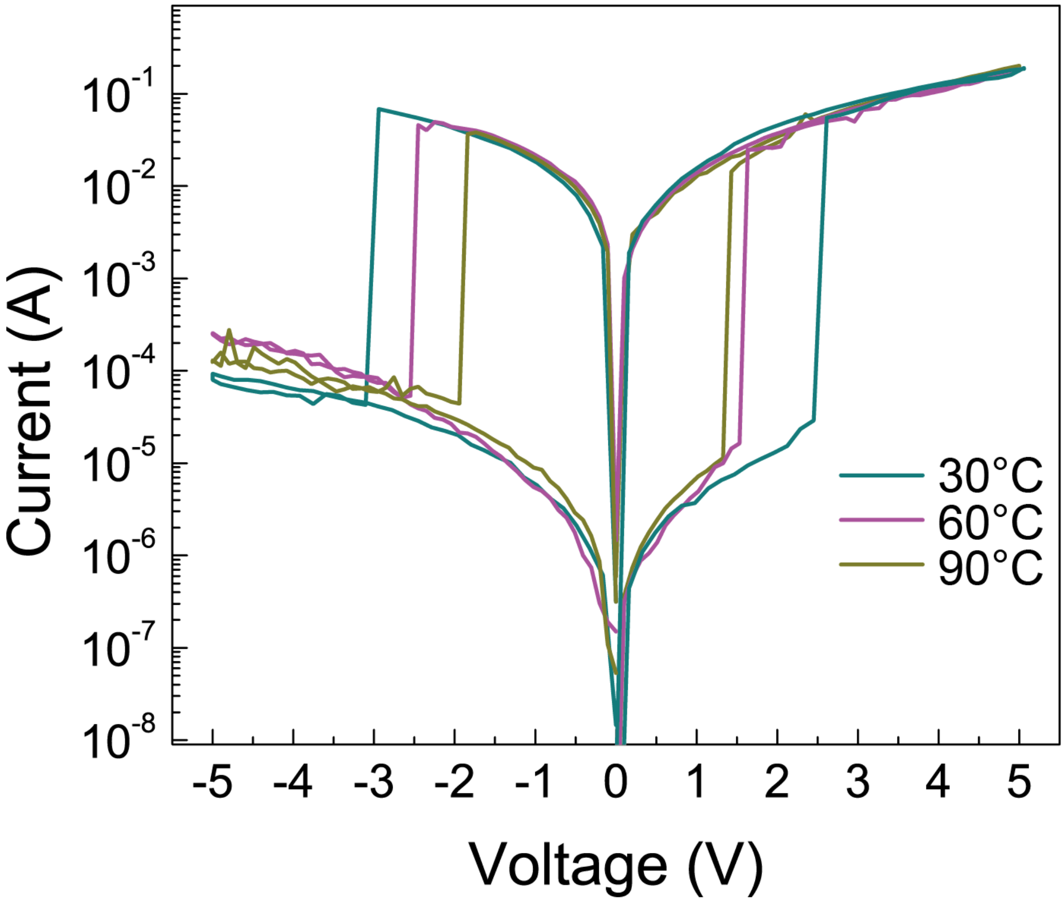

Fig. S4 Typical *I*-*V* tests under different temperatures for Al/BCPO/ITO device.

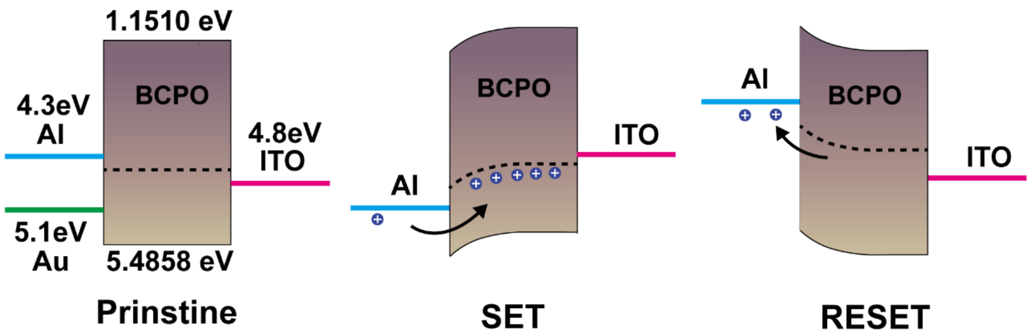

Fig. S5 Energy band diagram of pristine device and the device under SET/RESET operation.

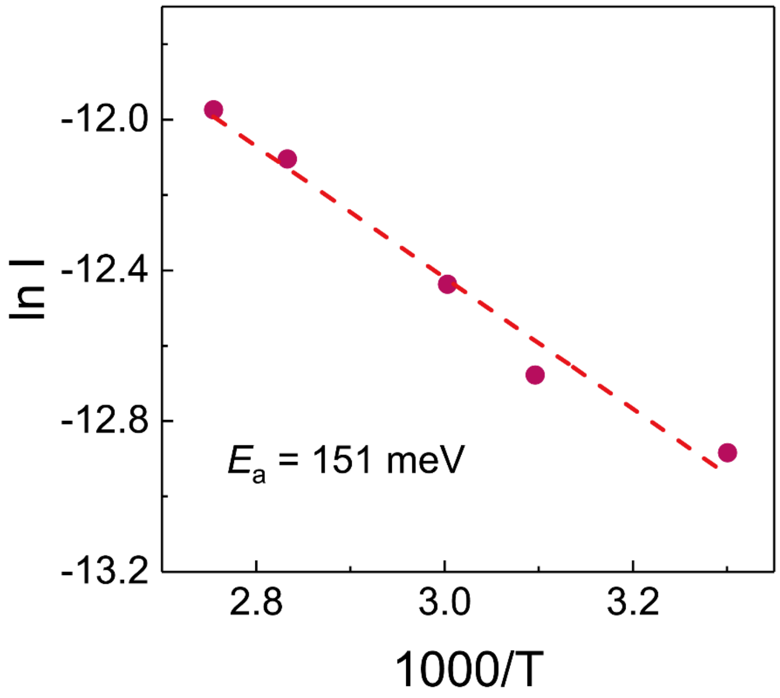

Fig. S6 The temperature dependence of currents in HRS.

Based on the SCLC model, the voltage where all the trap sites inside the dielectric layer are filled with charge carriers is defined as V_{TFL} (trap-filling limit voltage). With sufficient amount of traps, the current abruptly increase for several orders of magnitude in the SCLC trap-free regime. N_t, trap density can be presented with the following simple expression:

$$N_t \cong \frac{\varepsilon_0 \varepsilon_r}{e} \frac{V_{TFL}}{L^2}$$

where ε_0 is the permittivity of free space, and ε_r the dielectric constant of the dielectric layer. L represents the thickness of BCPO layer (65 nm). Therefore, the trap density is estimated to be 1.15 $\times 10^{17}$ cm^{-3}.[1]

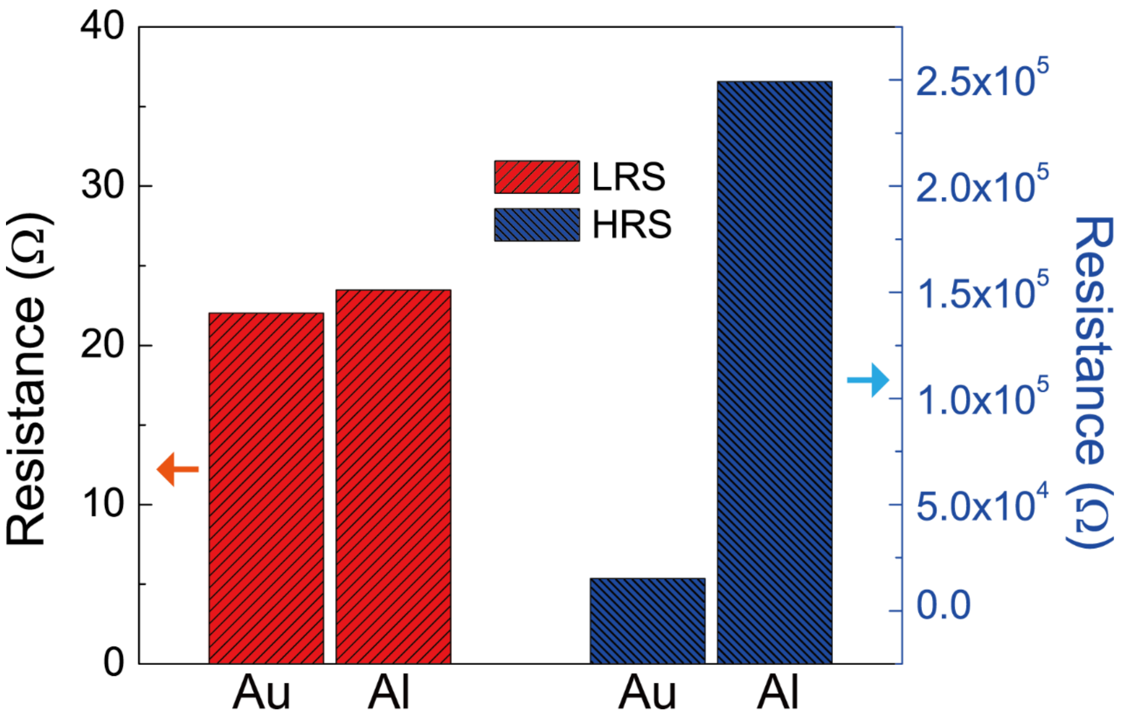

Fig. S7 Histogram of resistance comparison for devices with Au and Al top electrode at a read voltage of +0.5 V (red for LRS, blue for HRS).

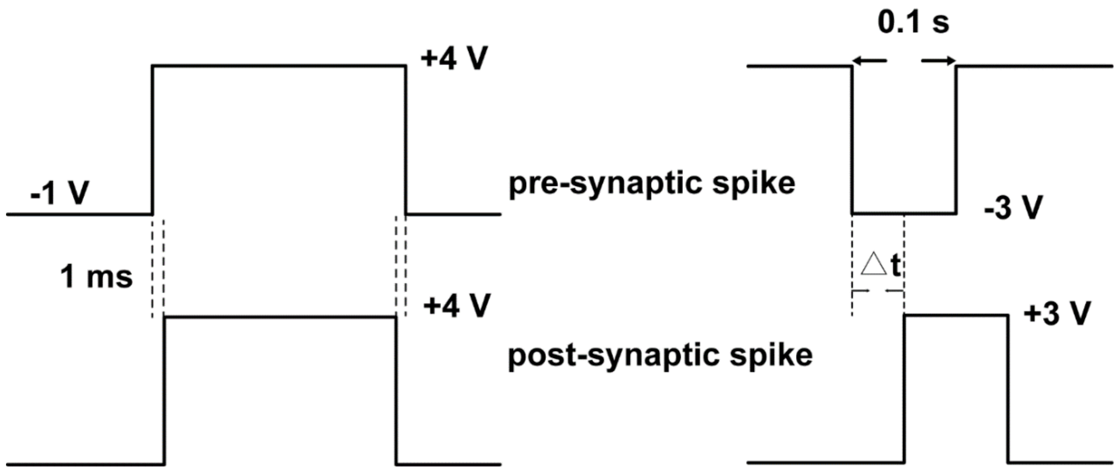

Fig. S8 Waveforms for two STDP forms, symmetric Hebbian learning rule and symmetric anti-Hebbian rule, respectively.

1. O. D. Jurchescu, *Handbook of Organic Materials for Optical & Electronic Devices*, 2013, 377-397.