Supporting Information

Memristive properties and synaptic plasticity in substituted pyridinium iodobismuthates

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KEYWORDS. Lead-free perovskite, neuromorphic electronics, pyridinium-based bismuth complexes, memristors.

Table S1. Extracted parameters from the fitted experimental data to the introduced model for the fabricated devices from pyridinium-based bismuthates samples as Tauc-Lorentz layer.

Name of the absorber layer	Thickness of Roughness	Thickness of absorber layer	n	k
4-AmpyBiI3	9.79 nm	202.78 nm	2.13	0.0204
4-MepyBiI3	13.98 nm	150.79 nm	2.33	0.0468
4-DmapyBiI3	20.49 nm	164.06.45 nm	2.1170	0.00068
4-CNpyBiI3	-	169.16	1.5648 (n_{xy} =1.6358; n_z = 1.4226)	0.38812 (k_{xy} =0.3363; k_z = 0.4917)

Table S2. Effect of the surface area of the electrode on LRS (ON) and HRS (OFF) states.[a]

Entry	Surface area/1 mm^2		Surface area/9 mm^2		Ratio ON[b]/ON[c]	Ratio OFF[b]/OFF[c]
	Current (mA)/ON	Current (mA)/OFF	Current (mA)/ON	Current (mA)/OFF		
4-CNpyBiI$_3$	2.58±0.1	1.46±0.1	3.00±0.1	2.03±0.2	1.16	1.39
4-MepyBiI$_3$	1.92±0.1	1.42±0.07	3.08±0.2	1.84±0.1	1.6	1.29
4-AmpyBiI$_3$	2.44±0.1	1.94±0.3	5.53±0.03	3.24±0.4	2.27	1.64

[a]The average amount of 5 different measured devices.

[b]surface area 1mm^2; [c]surface area 9mm^2

Table S3. Rectification factor for devices with different surface area of electrode.[a]

Entry	Surface area/1 mm^2		Ratio	Surface area/9 mm^2		Ratio
	Current (mA) at +2V	Current (mA) at -2V		Current (mA) at +2V	Current (mA) at -2V	
4-CNpyBiI$_3$	30.74±1	39.9±0.5	1.3	24.47±1	33.03±0.5	1.35
4-MepyBiI$_3$	38.34±0.8	48.02±1	1.25	31.47±0.5	39.05±1	1.24
4-AmpyBiI$_3$	78.65±1 [b]	104.24±1.5 [c]	1.33	75.48±1.5 [b]	83.92±1[c]	1.11

[a]The average amount of 5 different measured devices.

[b]measured at +4V; [c]measured at -4V

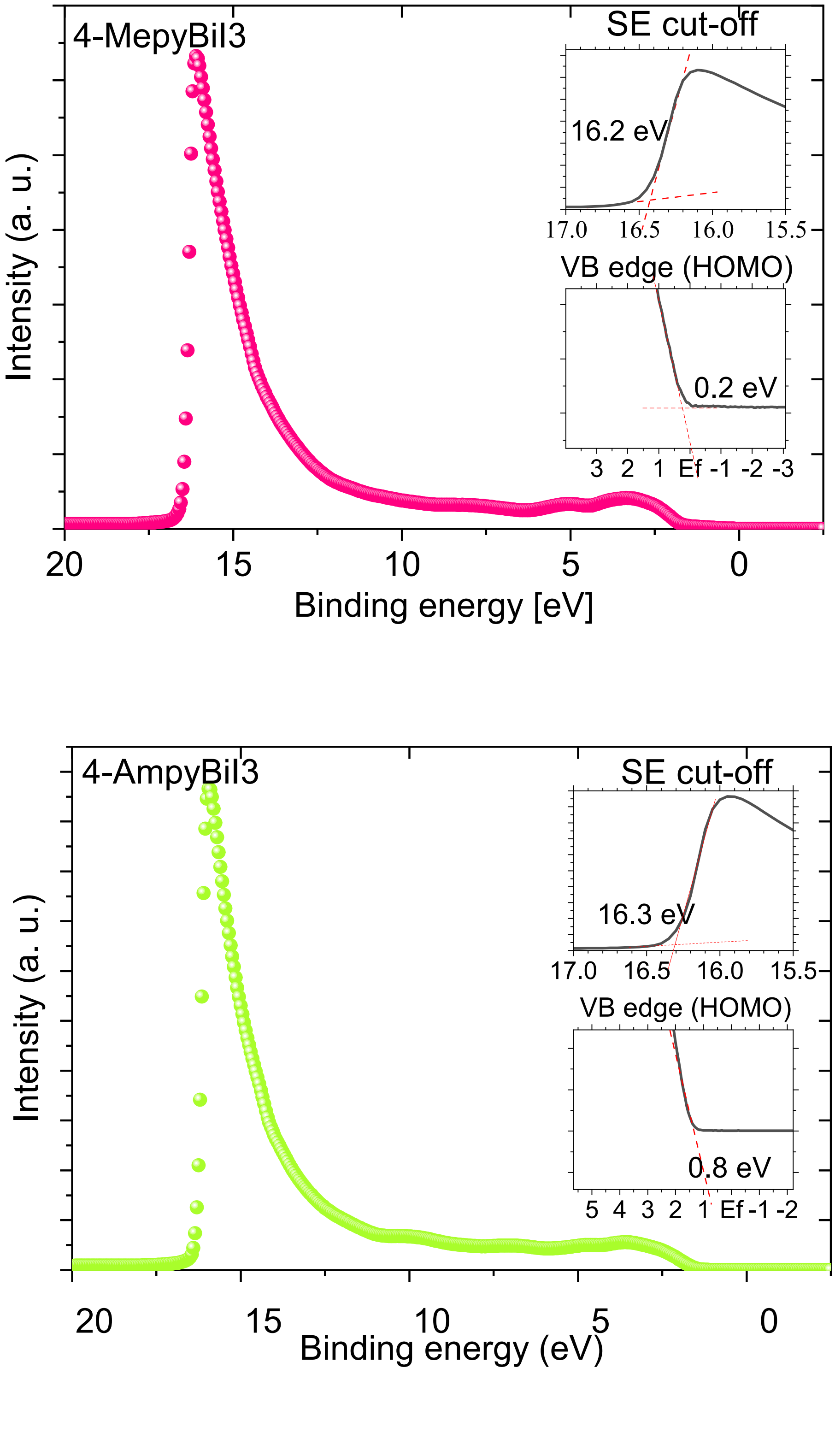


Figure S1. UPS spectra of thin films on ITO glasses a) 4-MetpyBiI_3 b) 4-AmpyBiI_3

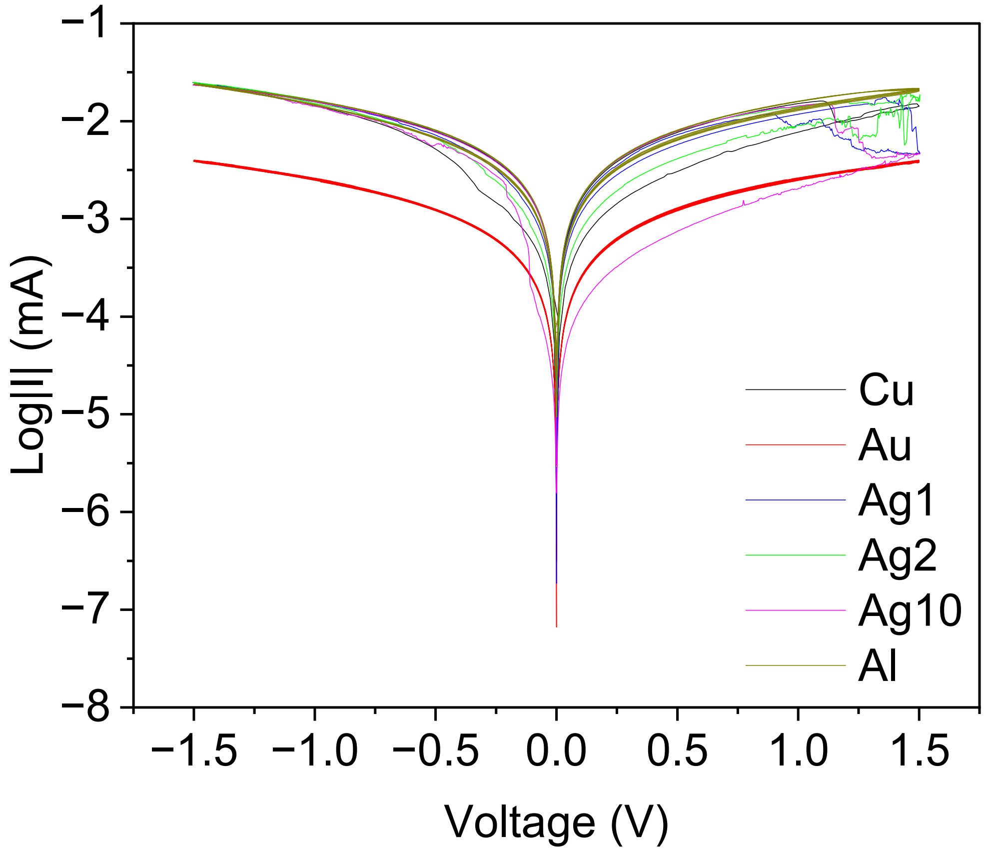


Figure S2. 4-CNpyBiI_3/ITO glasses with different metal electrodes as top electrode.

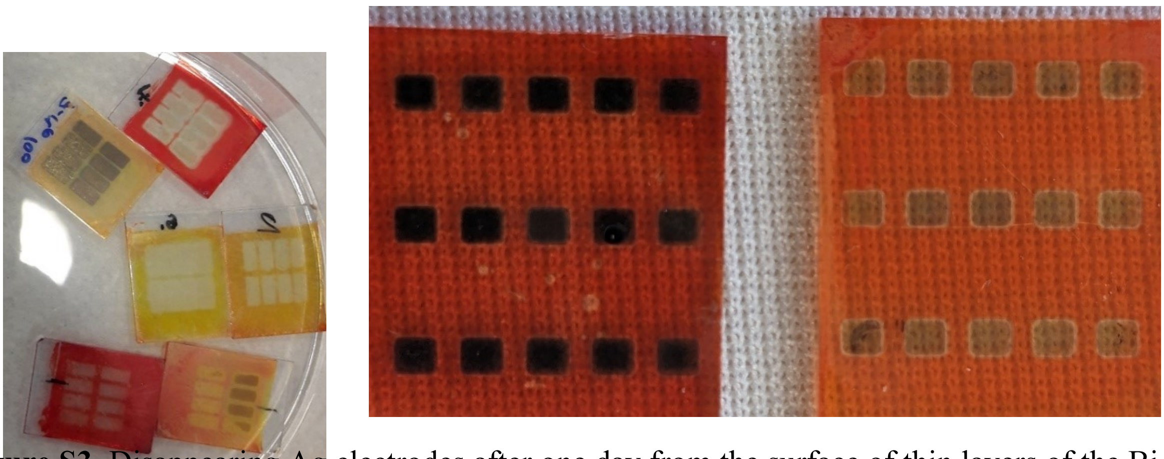
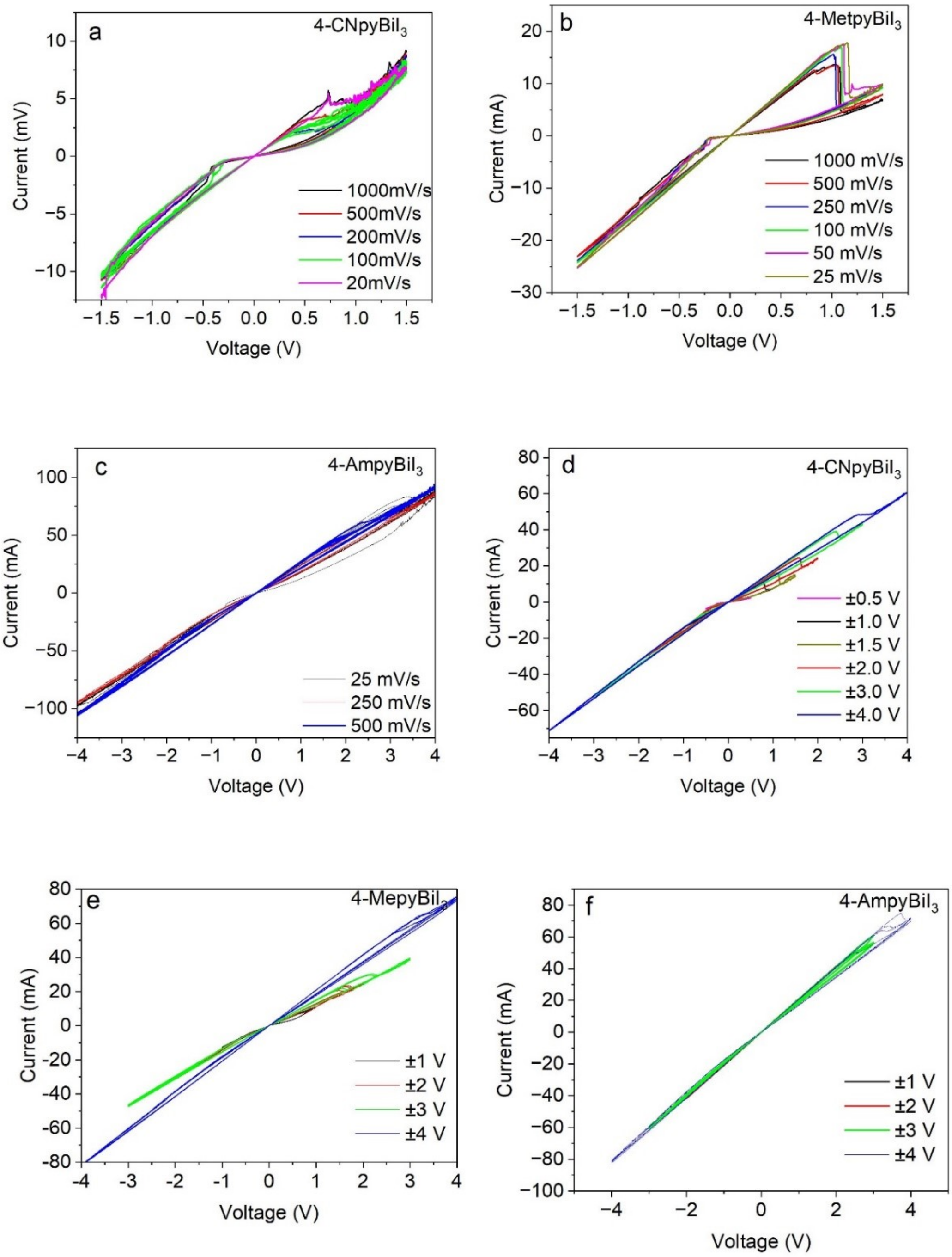


Figure S3. Disappearing Ag electrodes after one day from the surface of thin layers of the Bi-complexes on ITO/glasses.


a
4-CNpyBiI3
Current (mV)
Voltage (V)
1000mV/s
500mV/s
200mV/s
100mV/s
20mV/s
b
4-MetpyBiI3
Current (mA)
Voltage (V)
1000 mV/s
500 mV/s
250 mV/s
100 mV/s
50 mV/s
25 mV/s
c
4-AmpyBiI3
Current (mA)
Voltage (V)
25 mV/s
250 mV/s
500 mV/s
d
4-CNpyBiI3
Current (mA)
Voltage (V)
±0.5 V
±1.0 V
±1.5 V
±2.0 V
±3.0 V
±4.0 V
e
4-MepyBiI3
Current (mA)
Voltage (V)
±1 V
±2 V
±3 V
±4 V
f
4-AmpyBiI3
Current (mA)
Voltage (V)
±1 V
±2 V
±3 V
±4 V

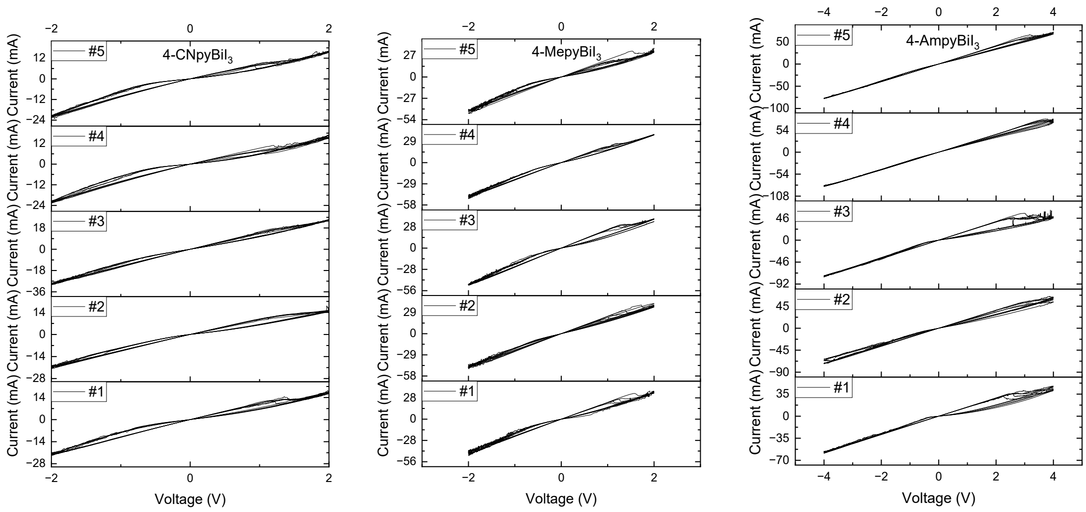
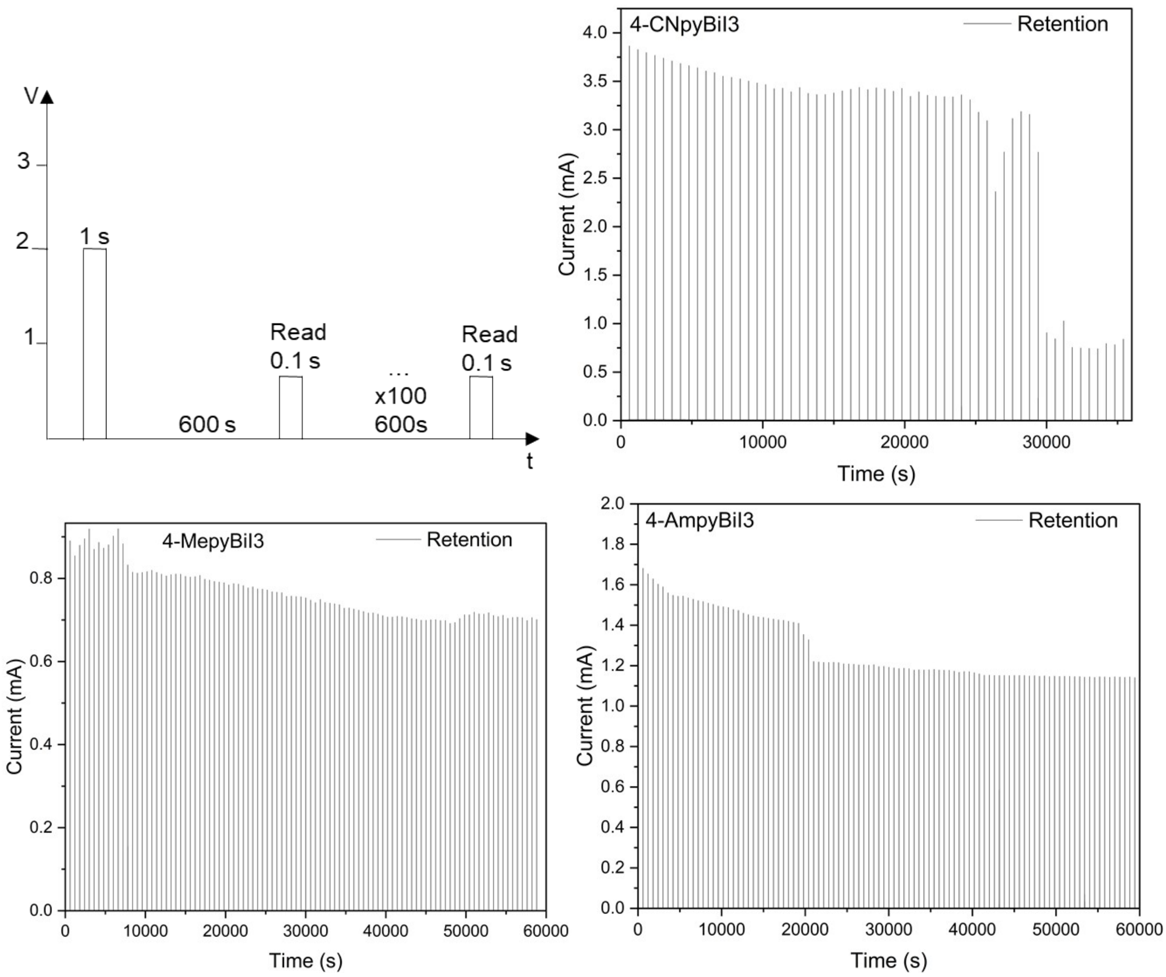
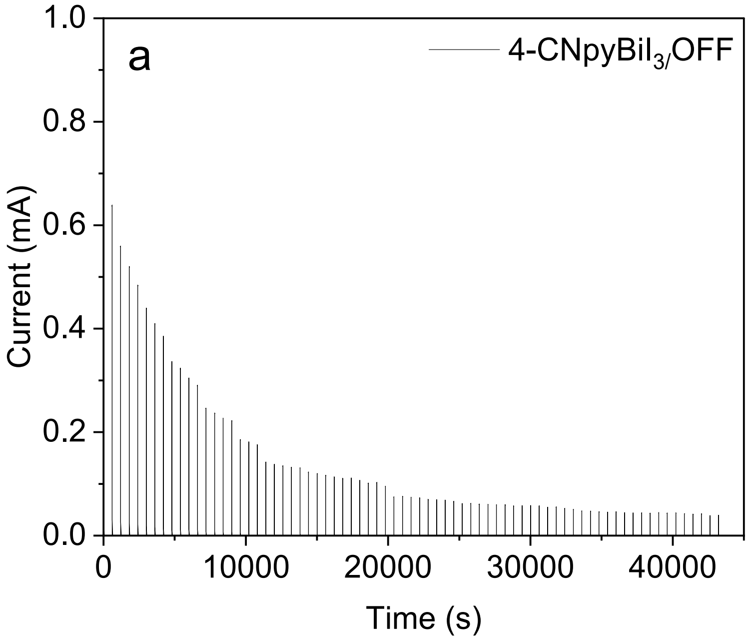
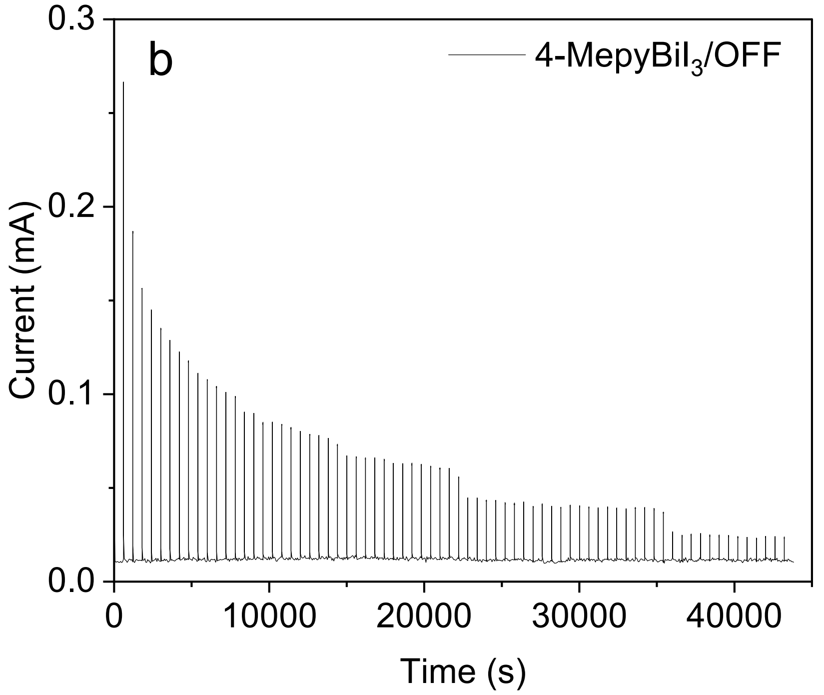


Figure S4. Scan rates a) Cu/4-CNpyBiI_3/ITO b) Cu/4-MepyBiI_3/ITO c) Cu/4-AmpyBiI_3/ITO. Voltage ranges d) Cu/4-CNpyBiI_3/ITO e) Cu/4-MepyBiI3/ITO f) Cu/4-AmpyBiI_3/ITO in different voltages range. Device-to-device reproducibility for 5 different batches of samples is also shown in bottom panel.


V
t
1 s
Read 0.1 s
600 s
...
x100
600s
Read 0.1 s
4-CNpyBiI3
Retention
Current (mA)
Time (s)
4-MepyBiI3
Retention
Current (mA)
Time (s)
4-AmpyBiI3
Retention
Current (mA)
Time (s)


a
4-CNpyBiI3/OFF
Current (mA)
Time (s)



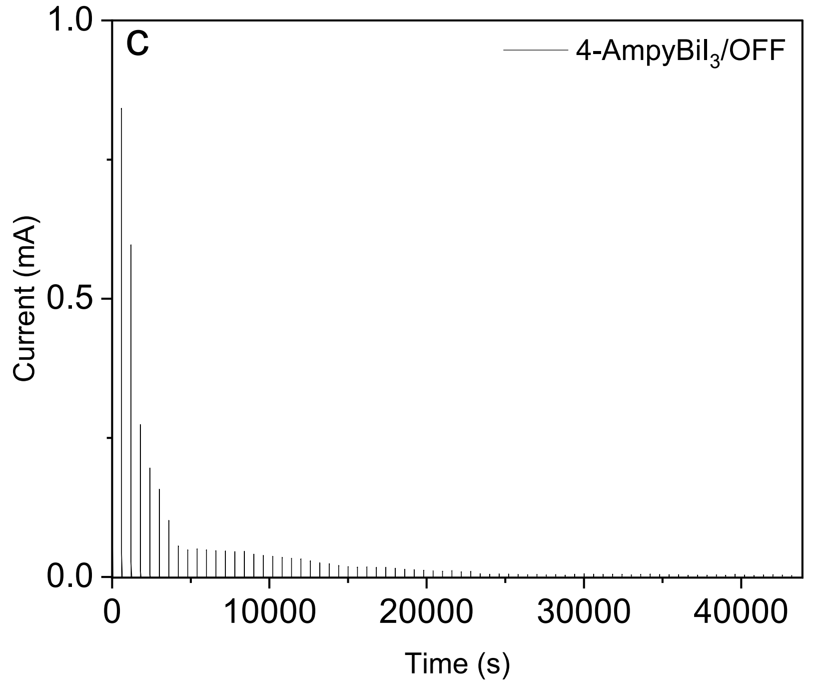


Figure S5. The Retention measurements of on and off states in 4-CNpyBiI$_3$ and 4-MepyBiI$_3$ at ±2 V as set and reset voltages. Retention measurements of the devices made of 4-AmpyBiI$_3$, ±4 V was chosen as the set and rest voltages and the read point was + 0.2 V. The width of all pulse was 0.1 s.

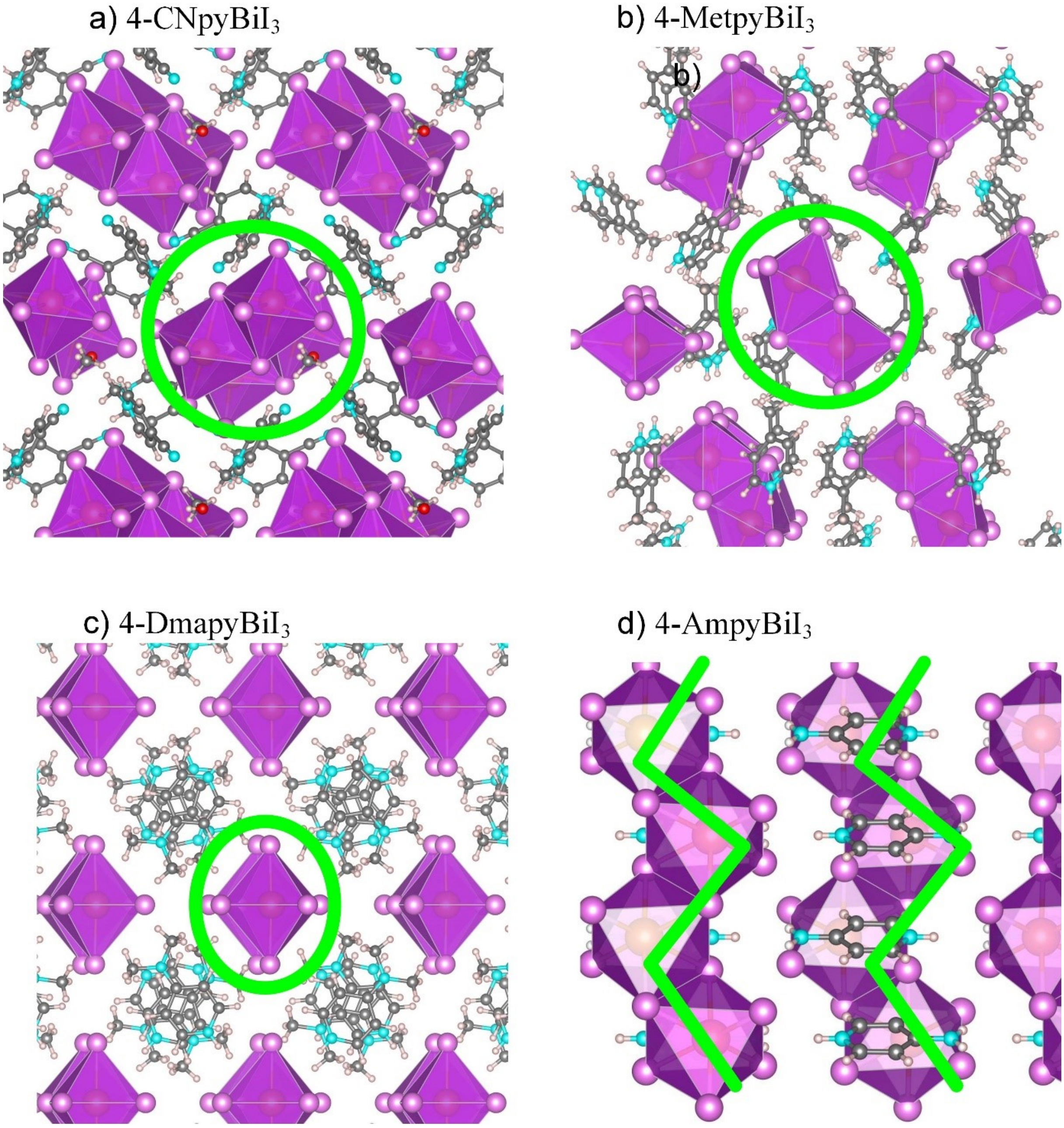


Figure S6. Representation of 0D a) 4-CNpyBiI_3 and b) 4-MepyBiI_3 c) 4-DmapyBiI_3 and 1D d) and 4-AmpyBiI_3 of ionic fragments of Bi-I and void shapes.

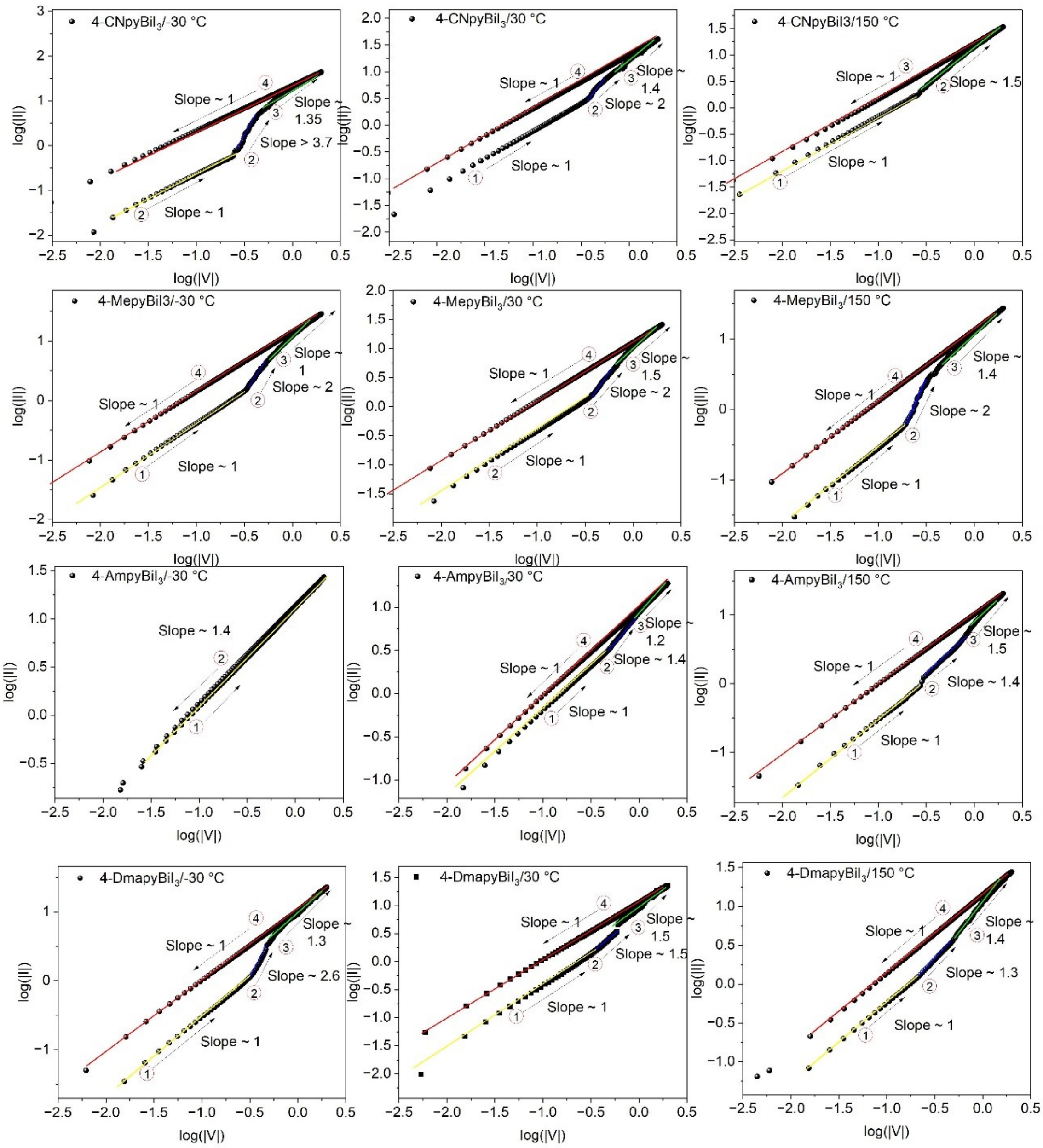


Figure S7. Double logarithmic scales of IV values of 4-CNpyBiI_3, 4-MepyBiI_3, 4-DmapyBiI_3 and 4-AmpyBiI_3 in SET process.

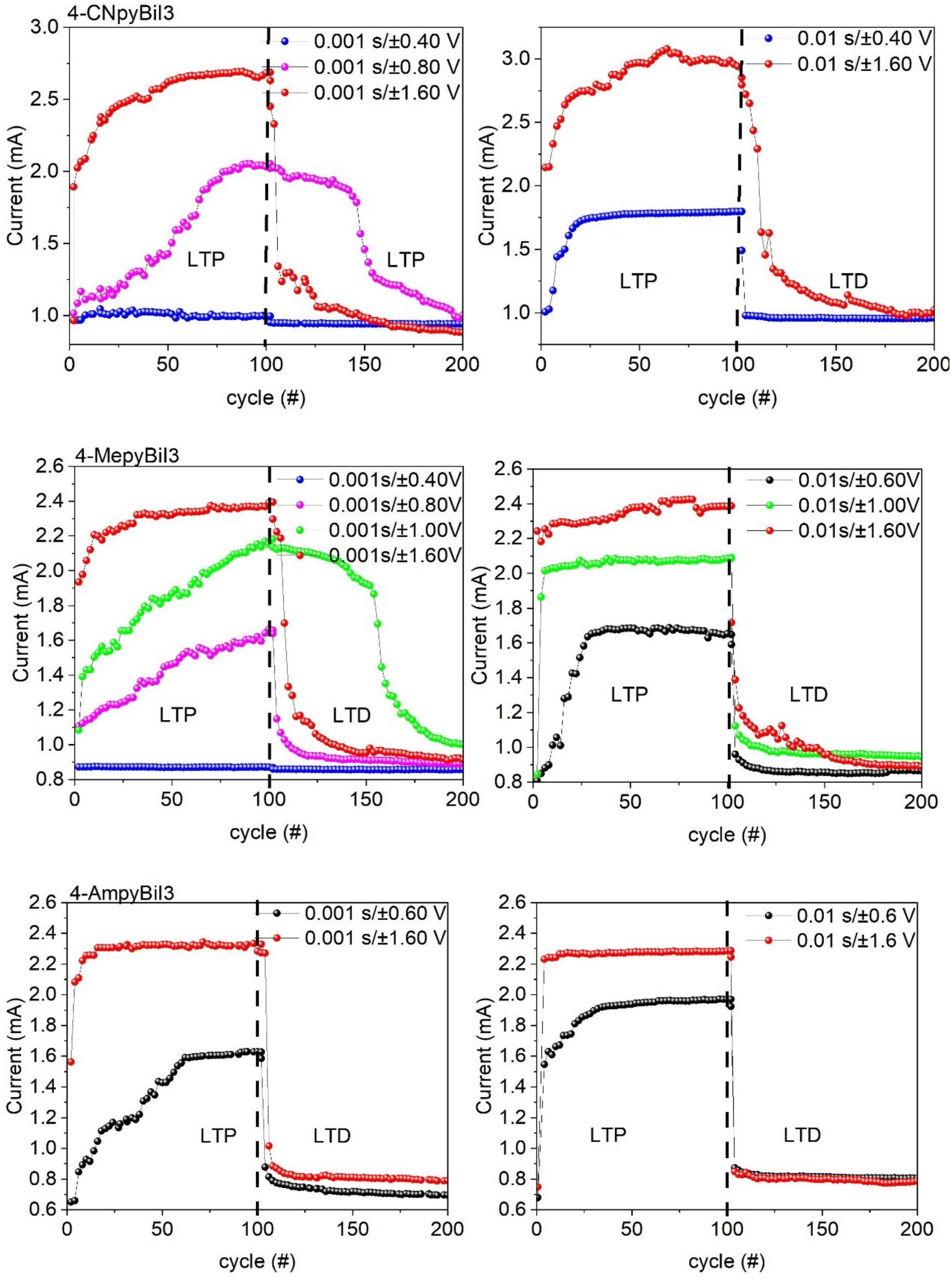


Figure S8. LTP and LTD for prepared devices with different pulse sequences with different width (0.001 s or 0.01 s) and amplitude 9between 0.4 V -1.6 V).

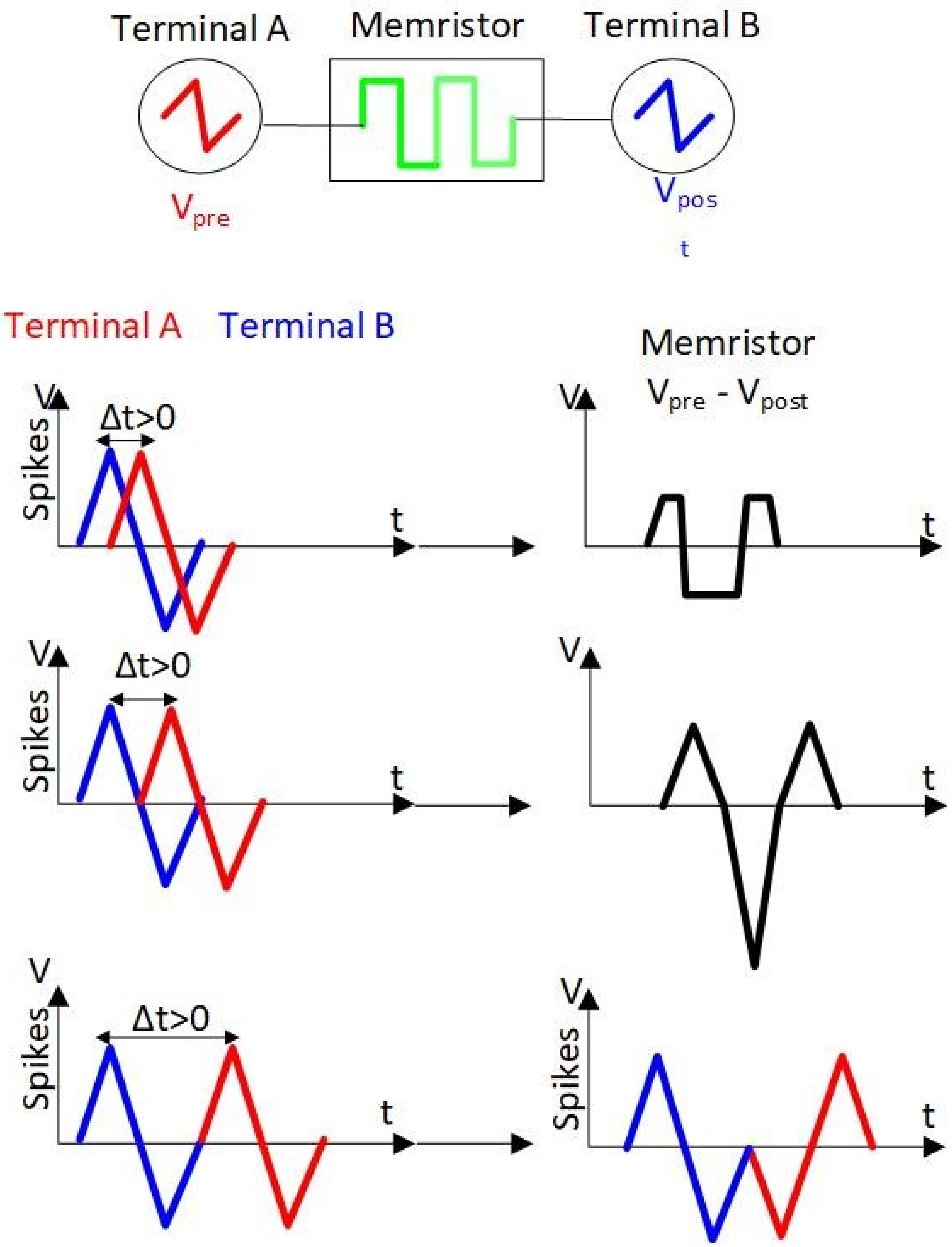


Figure S9. Illustration of final pulses shape on memristor devices, depends on time difference.

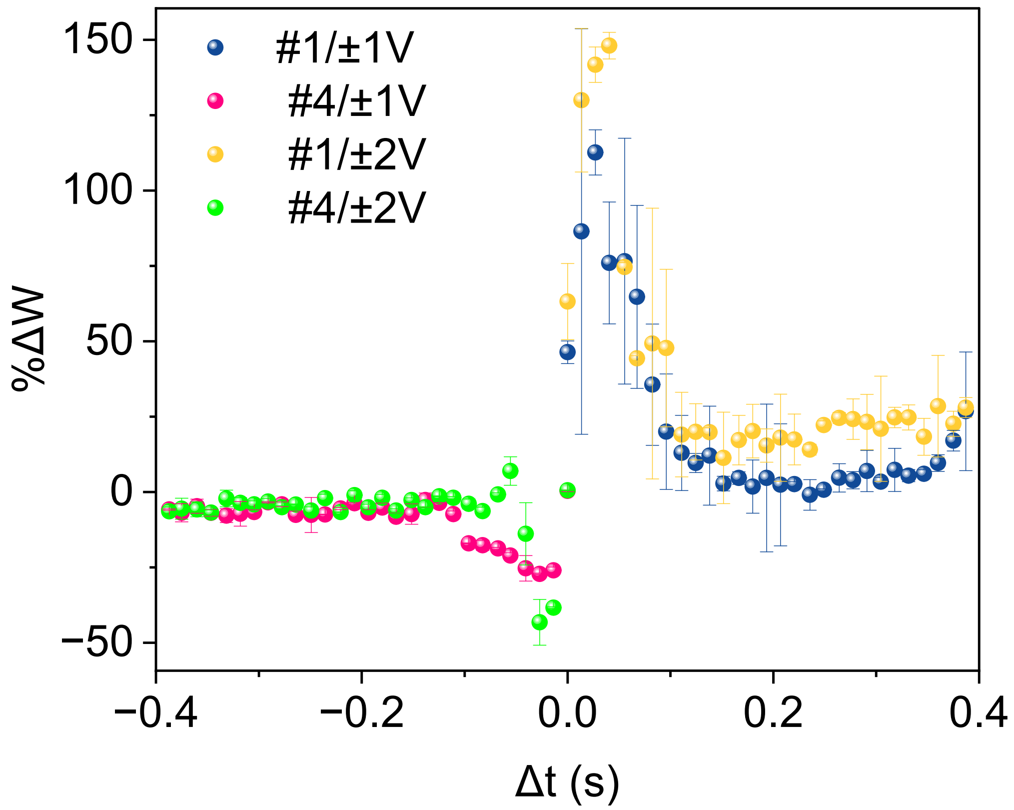


Figure S10. STDP of 4-CNpyBiI_3 with RT-pulse (#1 and #4) ; pulse amplitude to (±1 V) and pulse amplitude to (±2 V).

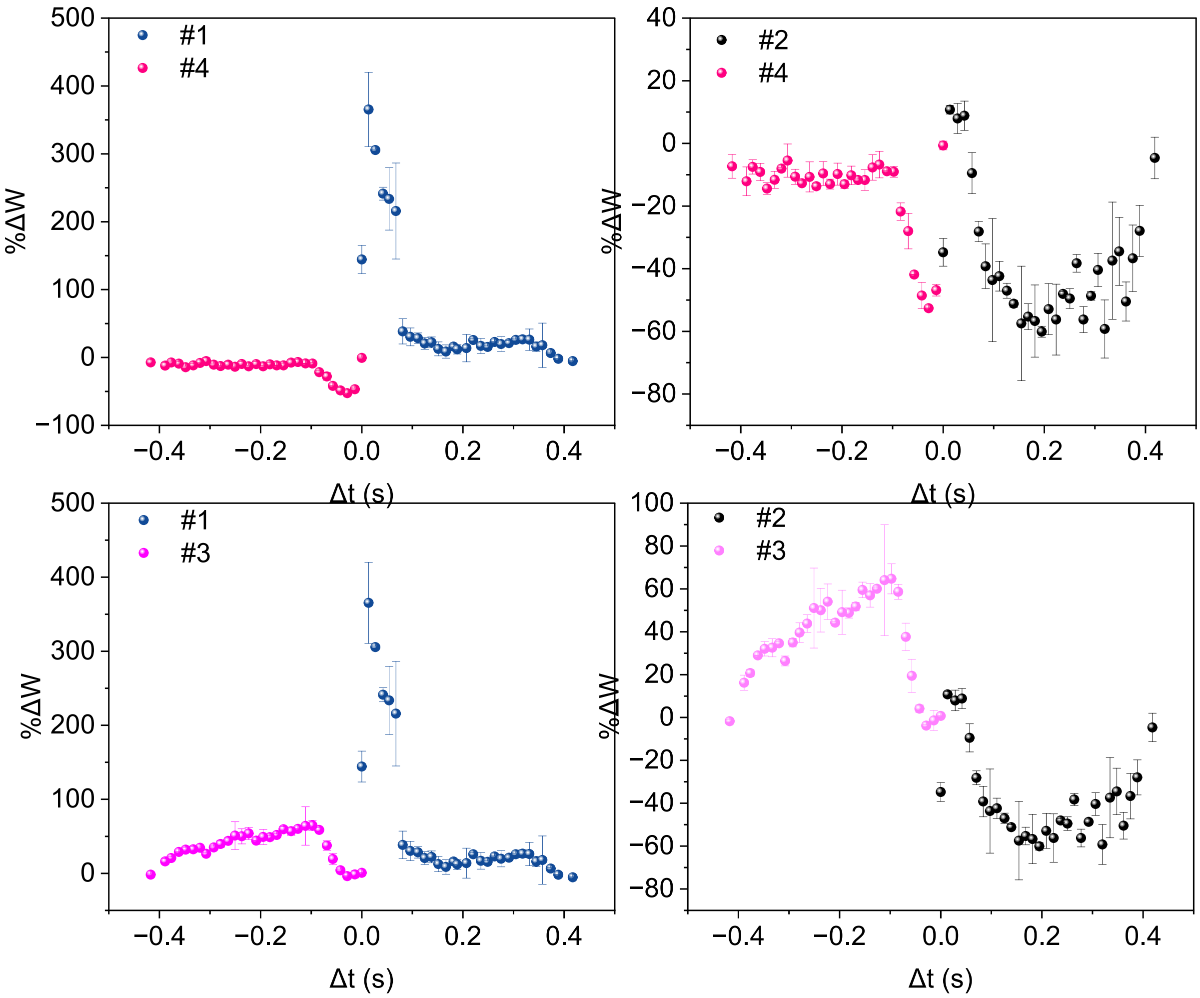


Figure S11. STDP of 4-MepyBiI_3 in different pulse polarities with ± 1 V amplitude.

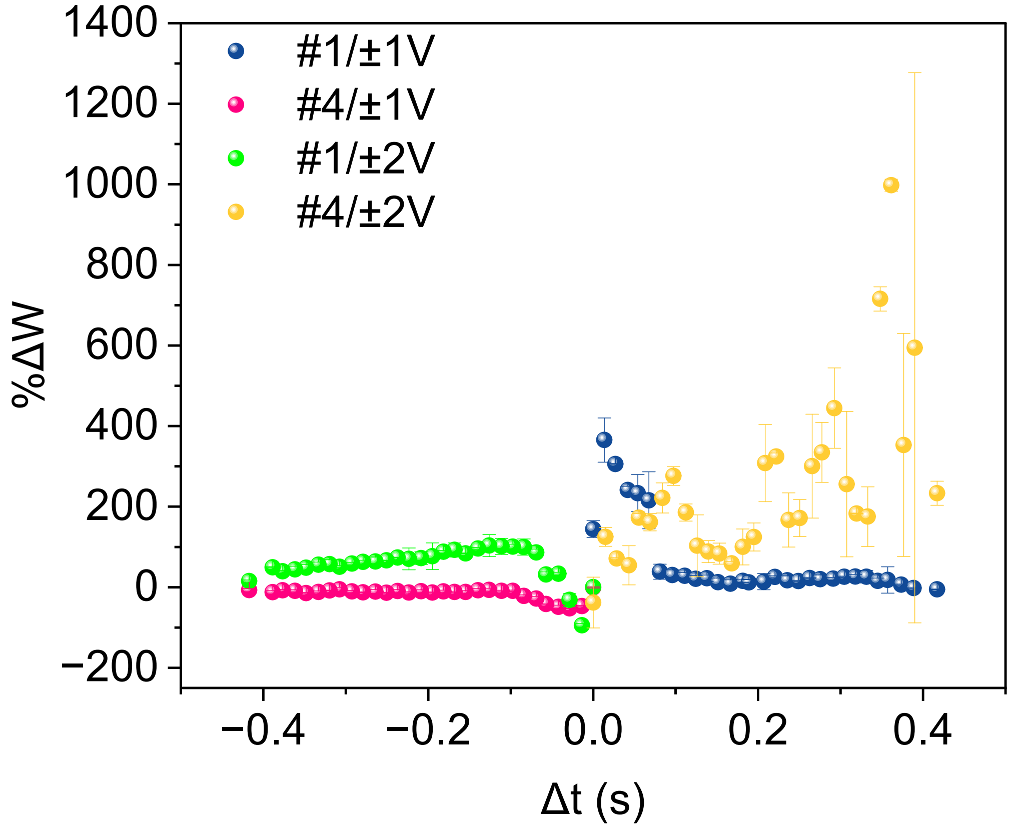


Figure S12. STDP of 4-MepyBiI_3 with RT-pulse (#1 and #4) ; pulse amplitude to (±1 V) and pulse amplitude to (±2 V).