Supplementary material

Device Structure	Endurance cycles	Ref.
FTO/$MAPbI_3$/Ag	10^3	J. Phys. Chem. C 2018, 122 (11), 6431–6436,
ITO/PEDOT:PSS/$MAPbBr_3$/Al	$1.2 \cdot 10^2$	Organic Electronics 2018, 62, 412–418
ITO/$Cs_{0.06}FA_{0.78}MA_{0.16}Pb(I_{0.92}Br_{0.08})_3$/Au	10^3	ACS Applied Electronic Materials 2020, 2 (11), 3695–3703
ITO/PEDOT:PSS/$MAPbI_3$/PMMA/Al	$2.1 \cdot 10^2$	Journal of Alloys and Compounds 2019, 783, 478–485
ITO/ $MAPbI_3$/ZnO/Au	10^3	Journal of Alloys and Compounds 2019, 811, 151999
Ag/ $MAPbI_3$/Ag	$2 \cdot 10^2$	ACS Nano 2018, 12 (2), 1242–1249
Si/SiO_2/Au/$MAPbI_3$/Au	$1.2 \cdot 10^3$	Advanced Materials 2019, 31 (21), 1804841
ITO/$MAPbI_{3-x}Cl_x$/2D Perovskite/Al	$3 \cdot 10^2$	ACS Appl. Mater. Interfaces 2020, 12 (13), 15439–15445
Si/SiO_2/Ti/Pt/$MAPbI_3$/Au	$5 \cdot 10^2$	Advanced Materials 2017, 29 (29), 1701048
Si/Pt/δ-$FAPbI_3$/Ag	$1.2 \cdot 10^3$	Advanced Electronic Materials 2018, 4 (9), 1800190
This Work	$3 \cdot 10^3$	-

Table S1: Literature summary of the endurance perovskite-based memristors in comparison with the devices of present study.

Structure	V_{set}/V_{Reset}	ON/OFF	Endurance	Retention	Mechanism	Ref.
FTO/$MAPbI_{3-X}Cl_x$/Au	1.47 /-1.41	10^4	$5\cdot10^1$	$4\cdot10^4$	Hole trapping at Perovskite/Au Interface	Advanced Functional Materials 2018, 28 (15), 1800080
Au/$(PEA)_2PbBr_4$/Graphene	2.8/-1	10^1	10^2	10^3	Formation/Rupture of V_{Br} CFs	ACS Nano 2017, 11 (12), 12247–12256
ITO/$MAPbI_{3-X}$/Ag	0.32/-0.52	10^4	$5\cdot10^2$	$1.2\cdot10^3$	Formation/Rupture of V_I CFs	Advanced Functional Materials 2019, 29 (5), 1806646
Si/SiO_2/Ti/Au/$MAPbI_3$/Au or Ag	0.32/-0.13	10^6	10^3	$1.2\cdot10^3$	Formation/Rupture of V_I CFs	Advanced Materials 2017, 29 (29), 1700527
TiN/Hf/HfO_x/TiN	≈ 0.5/-0.5	$5\cdot10^1$	$5\cdot10^7$	>10 years	Formation/ Rupture of Metallic CFs	International Electron Devices Meeting; 2011; p 31.6.1-31.6.4
Ni/GeO/STO/TaN	-1.1/0.13	$3\cdot10^6$	10^6	$4\cdot10^5$	Hopping via defects	2010 Symposium on VLSI Technology, 2010, pp. 85-86
Pt/TaO_x/Pt	-0.9/2	$1\text{-}2\cdot10^1$	>10^9	>10years	Shottky Barrier modification at Pt/TaO_x interface	IEEE International Electron Devices Meeting; 2008; pp 1–4
ITO/PEDOT:PSS/$MAPbBr_3$/Al	-0.2/3	$3.6\cdot10^6$	$1.2\cdot10^2$	10^4	Formation/Rupture of V_{Br} CFs	Organic Electronics 2018, 62, 412–418
ITO/$CsPbI_3$/Ag	-0.1/0.8	10^6	10^2	10^3	Formation/Rupture of V_I CFs	Advanced Materials Interfaces 2019, 6 (7), 1802071
ITO/$Cs_2AgBiBr_6$/Au	1.53/-3.4	10^3	$1.3\cdot10^3$	10^5	Formation/Rupture of Ag and V_I CFs	Small 2019, 15 (49), 1905731
This Work	0.15/-0.65	10^5	$3\cdot10^3$	$3.6\cdot10^3$	Formation/Rupture of V_I CFs	-

Table S2: Literature summary of different memristors technologies in terms of switching characteristics and mechanism.

Structure	PV Cell	Memory	Photo-Memristor	Synapses	Photo-Synapses	Energy Consumption	Ref.
FTO/PZT/PCBM:P3HT/V_2O_5/Ag	✓	✓	×	×	×	-	Advanced Functional Materials 2018, 28 (17), 1–7
FTO/c-TiO_2/m-TiO_2/RbCsFAMA/Spiro-OMeTAD/Au	✓	✓	×	×	×	-	Solar RRL 2021, 5 (4), 2000707
FTO/$MAPbI_{3-x}Cl_x$/Au	×	✓	✓	×	×	-	Advanced Functional Materials 2018, 28 (15), 1800080
ITO/$MAPbBr_3$/Au	×	✓	✓	×	×	-	Advanced Functional Materials 2018, 28 (3), 1704665
SiO_2/Si/Pt/Ti/$(Cs_3Bi_2I_9)_{0.4}(CsPbI_3)_{0.6}$/Ag	×	✓	×	✓	×	-	Advanced Functional Materials 2019, 29 (49), 1906686
FTO/$MAPbI_3$/Ag	×	✓	×	✓	×	47 fJ/μm^2	Journal of Alloys and Compounds 2020, 833, 155064
n+Si/PEDOT:PSS:PFI/$MAPbBr_3$/Al	×	✓	×	✓	×	20 fJ	Advanced Materials 2016, 28 (28), 5916–5922
ITO/PEDOT:PSS/$MAPbI_3$/Au	×	✓	×	✓	✓	55 fJ	Advanced Electronic Materials 2016, 2 (7), 1600100
Au/$(PEA)_2PbBr_4$/Graphene	×	✓	×	✓	×	400 fJ	ACS Nano 2017, 11 (12), 12247–12256
ITO/KI-$MAPbI_3$/Au	×	✓	×	✓	✓	-	Advanced Electronic Materials 2021, 7 (8), 2100291
ITO/PEDOT:PSS/pTPD/OGB Capped $CsPbBr_3$ Nanocrystals/Ag	×	✓	×	✓	×	-	Nat. Comm. 2022, 13 (1), 2074
TiN/$Hf_{0.5}Zr_{0.5}O_2$/Pt	×	✓	×	✓	×	1.8 pJ	Nanoscale 2018, 10 (33), 15826–15833
Pt/$AlO_y$$HfO_x$/TiN	×	✓	×	✓	×	0.29 pJ	ACS Nano 2014, 8 (7), 6998–7004.
ITO/PMMA/Bi_2Se_3/$MoSe_2$/Ag	×	✓	✓	✓	✓	100 pJ	Small 2019, 15 (7), 1805431
Au/MoS_2/Cu	×	✓	×	✓	×	-	Nano Lett. 2019, 19, 4, 2411–2417
ITO/BCPO/Al	×	✓	×	✓	×	-	J. Chem. C 2019, 7 (6), 1491–1501
Ta/PEDOT:PSS/Ag	×	✓	×	✓	×	-	J. Mater. Chem. C 2013, 1 (34), 5292–5298
This Work	✓	✓	✓	✓	✓		

Table S3: Literature summary of different memristor technologies in terms of multifunctionalities such as PV, memory, photomemristor and synaptic functions.

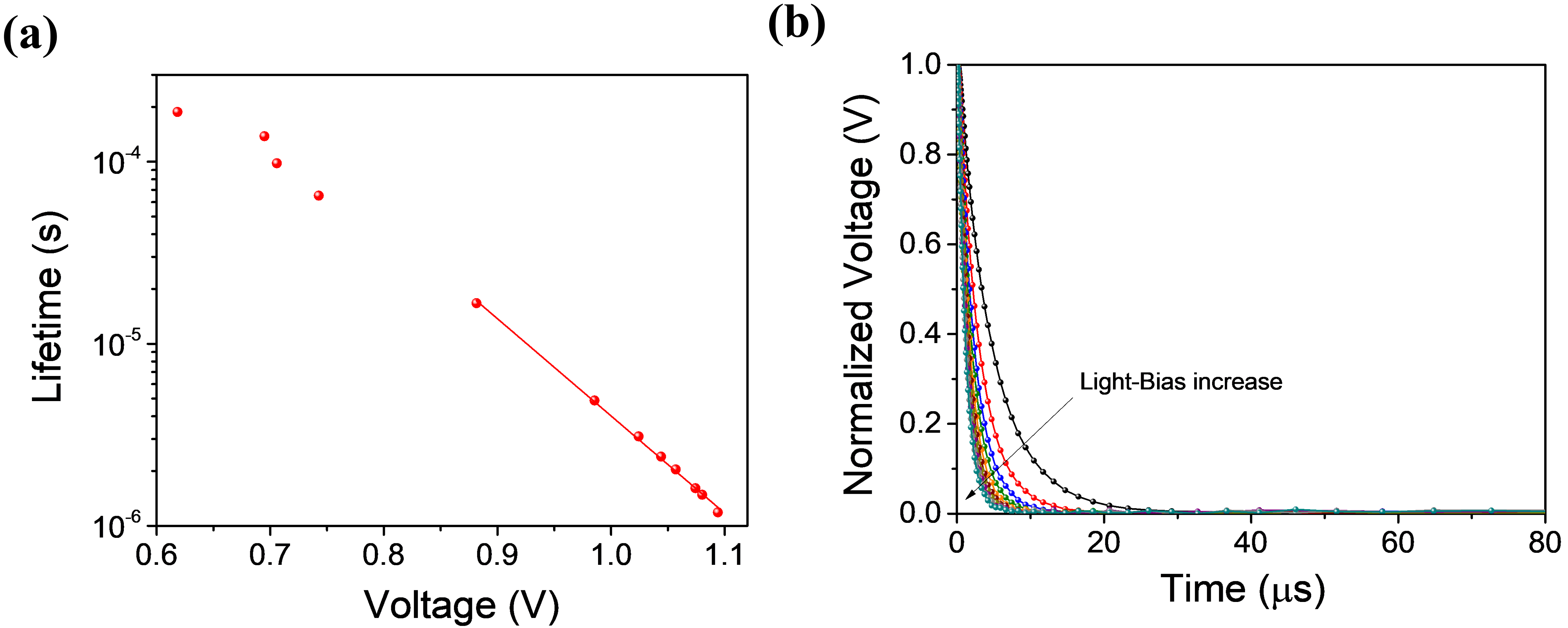
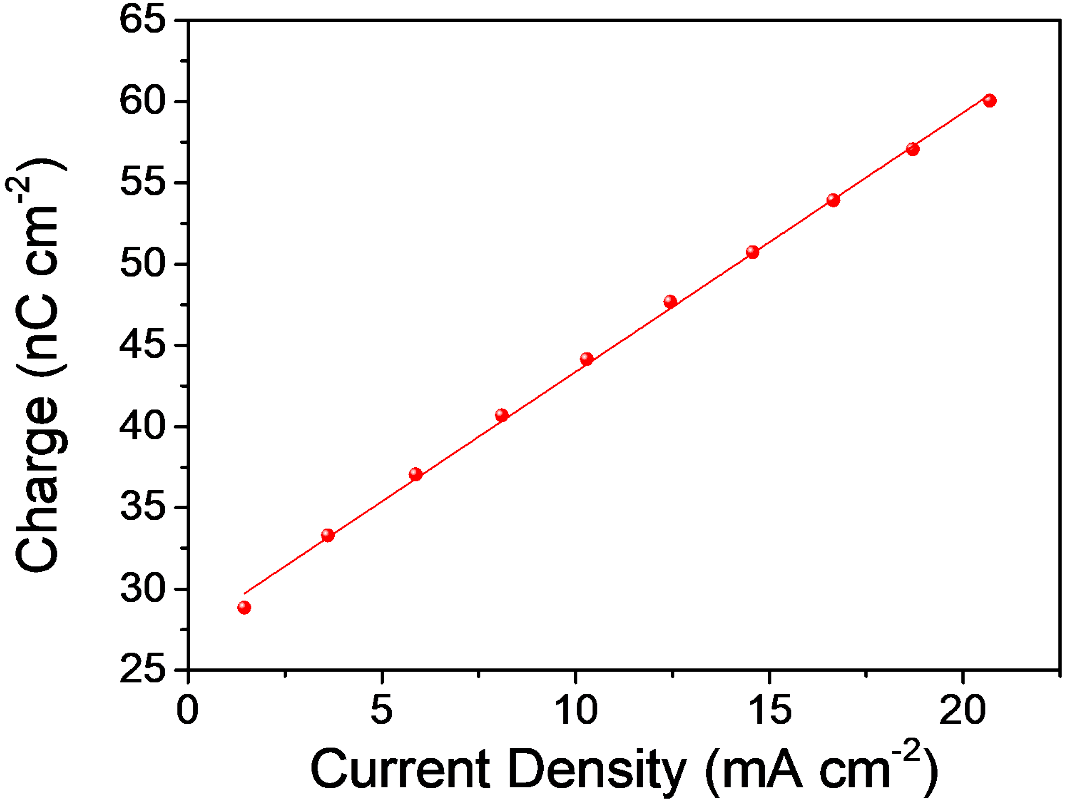


Figure S1. TPV of MemPVCell-1. a) TPV Lifetime as a function of voltage. **b)** TPV Decays for various light intensities

(a)

(b)



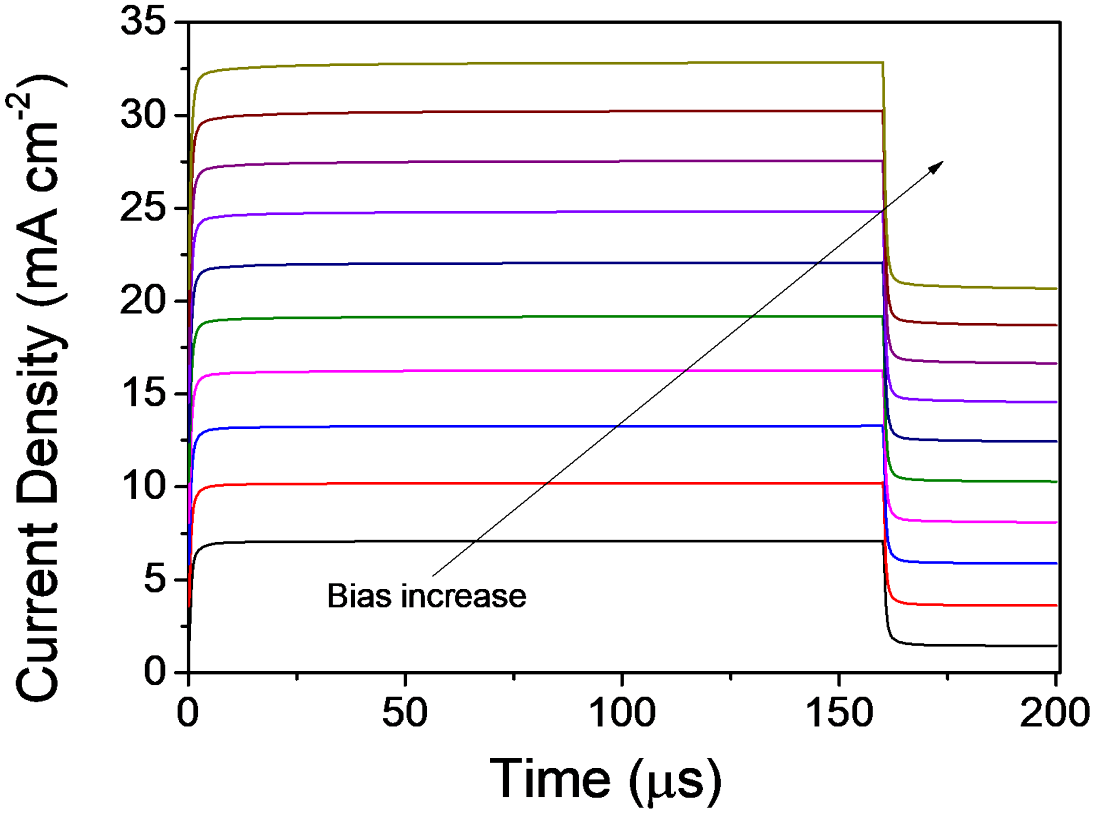


Figure S2. TPC of MemPVCell-1. (a) Extracted Charge as a function of Current Density. **(b)** Recorded TPC Transients for various light intensities

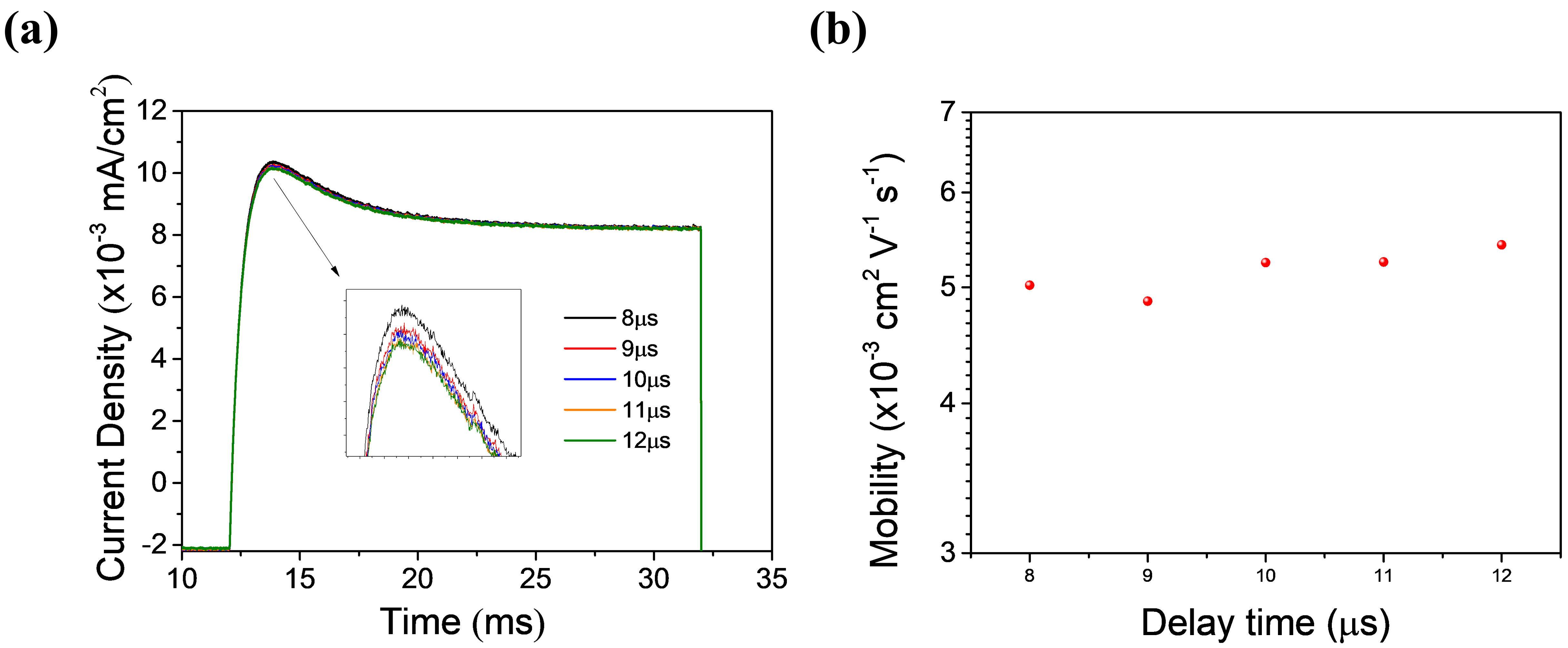


Figure S3. Photo-CELIV measurements of MemPVCell-1 towards mobility extraction. (a) Recorded Photo-CELIV Transients for Pulse-Ramp delay times ranging from 5-10μs. (b) Mobility as a function of delay time extracted based on raw data of (a).

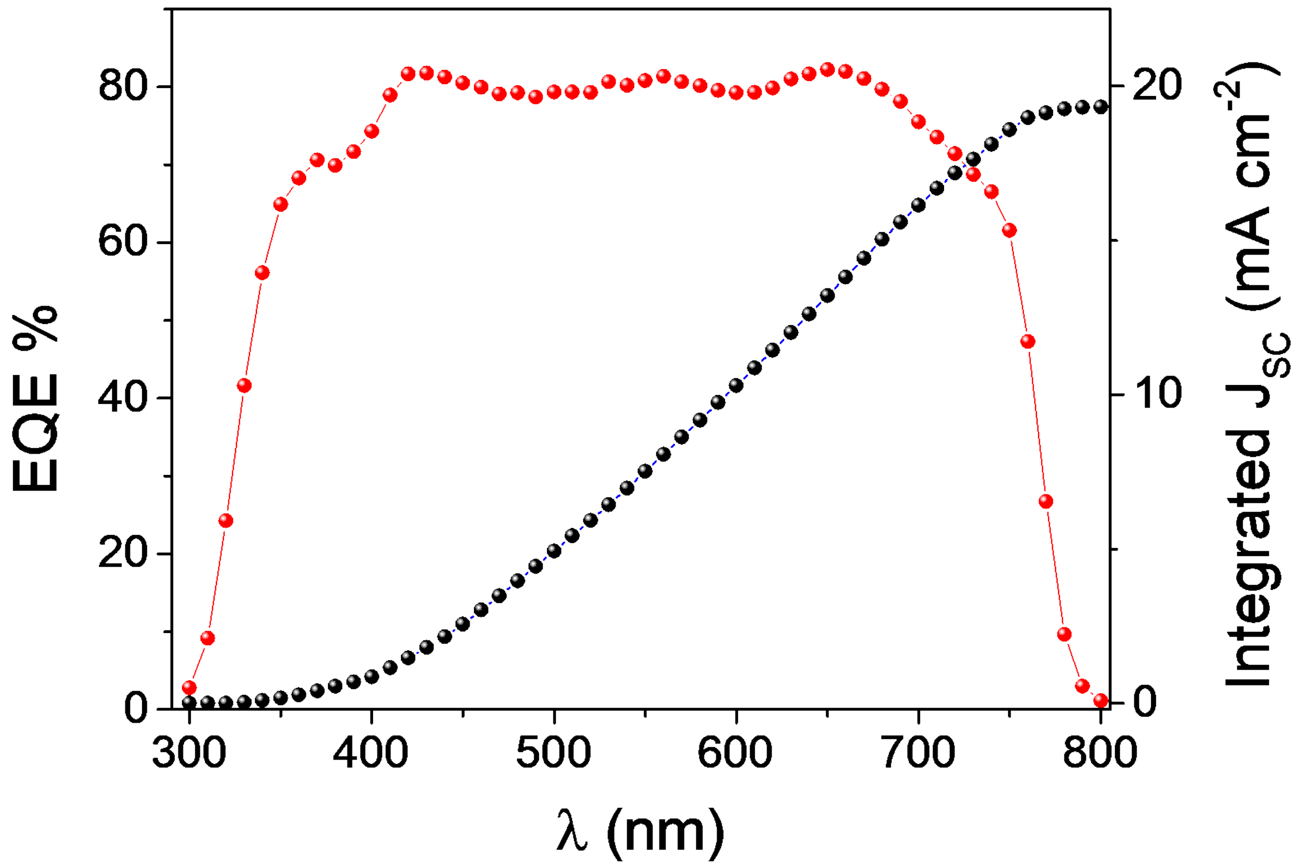


Figure S4. EQE Spectrum of the MemPVCell-1. The Integrated J_{SC} is equal to 19.33 mA cm^{-2} in agreement with values reported in Figure 2.

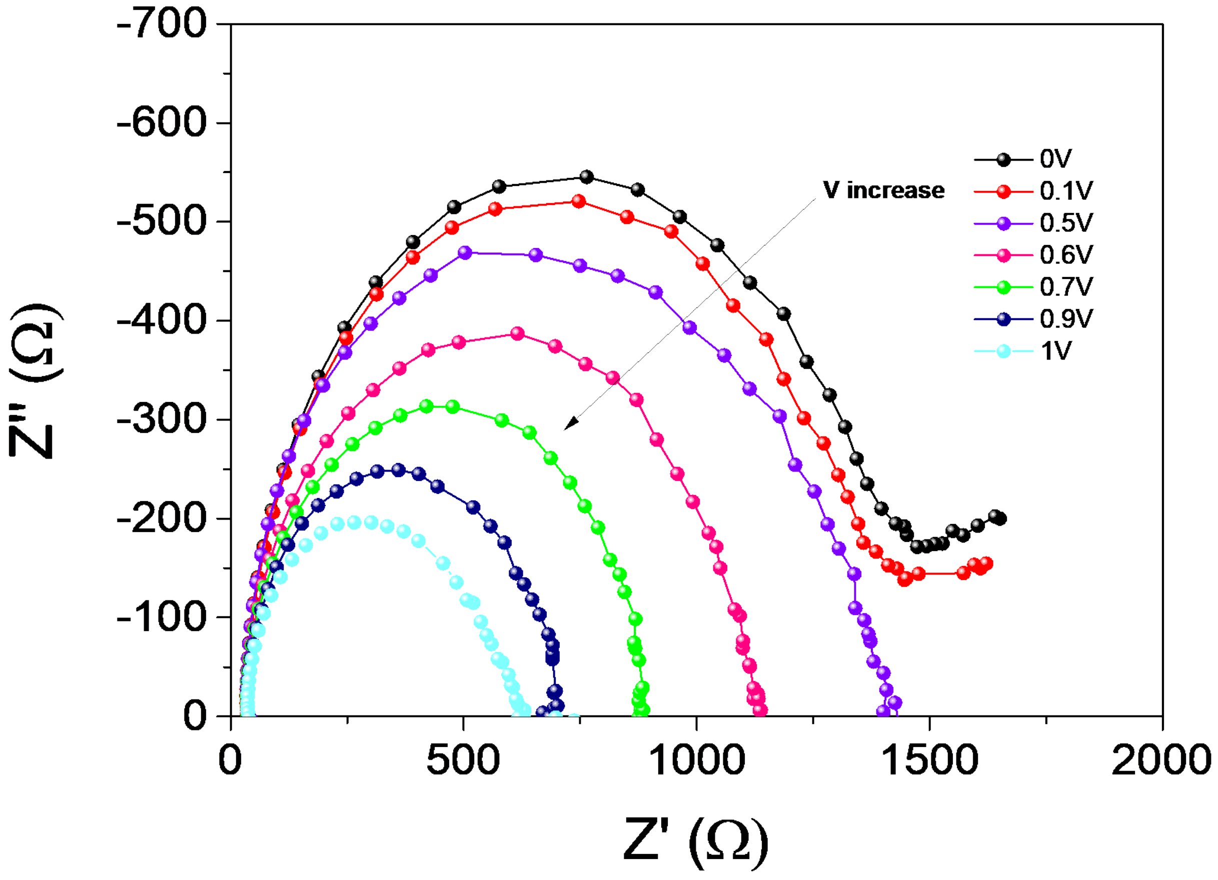


Figure S5. Electrochemical Impedance Spectroscopy data of MemPVCell-1 before the memristive channel formation at different dc bias varying from 0 to 1 volt.

Set Voltage (V)	Reset Voltage (V)
0.13	-0.79
0.2	-0.62
0.16	-0.46
0.35	-0.48
0.15	-0.62
0.11	-0.77
0.09	-0.75
0.15	-0.76
0.11	-0.68
0.12	-0.71
0.22	-0.6
0.17	-0.66
0.12	-0.49
0.12	-0.69
0.11	-0.69
0.15±0.06	**-0.65±0.10**

Average Set and Reset Voltage for MemPVCell-1

Set Voltage (V)	Reset Voltage (V)
0.14	-0,89
0.11	-0.77
0.18	-0.7
0.11	-0.7
0.16	-0.78
0,24	-0.64
0.12	-0.77
0.13	-0.78
0.13	-0.67
0.11	-0.83
0.13	-0.72
0.11	-0.75
0.11	-0.83
0.1	-0.71
0.09	-0.72
0.13±0.04	**-0.75±0.06**

Average Set and Reset Voltage for MemPVCell-2

Table S4. Average Set and Reset Voltages for MemPVCell -1 and MemPVCell-2 devices. Icc=10mA and a scanning rate of 10 mV s^{-1} were used.

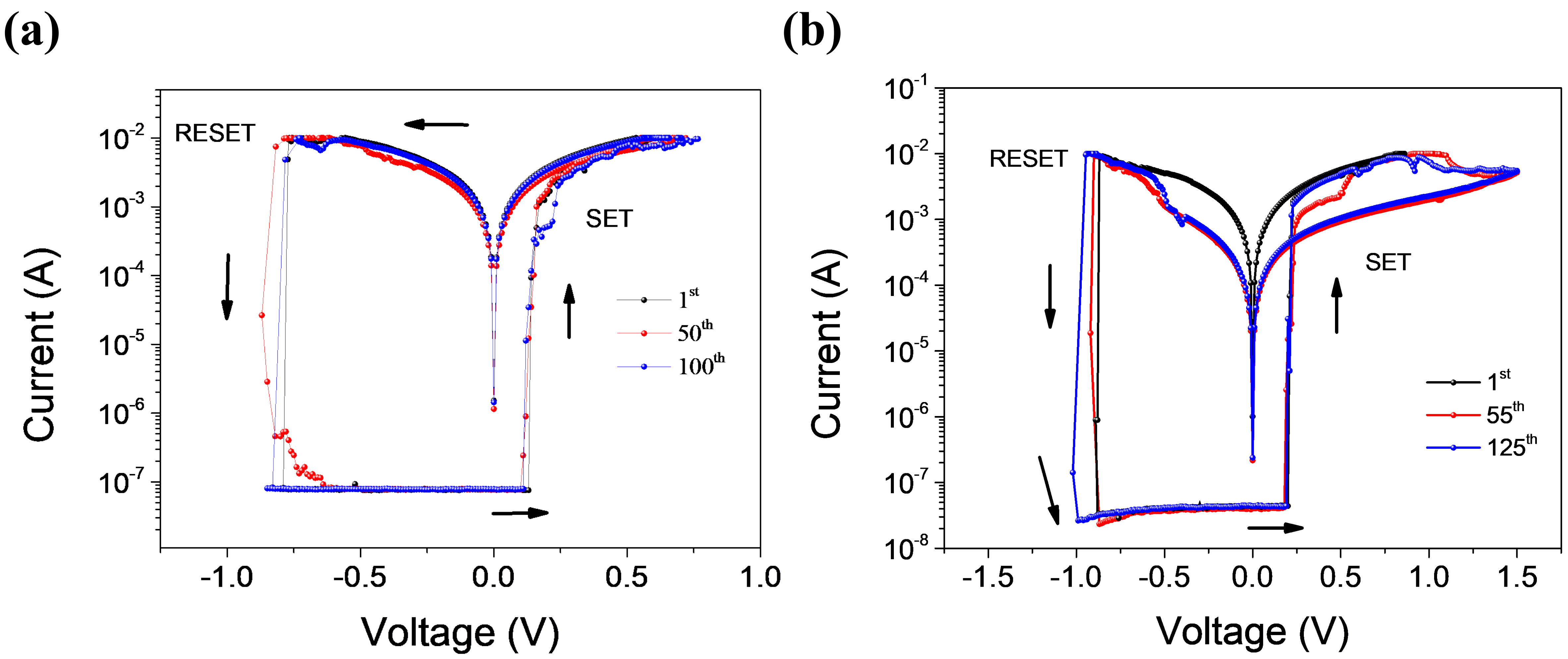
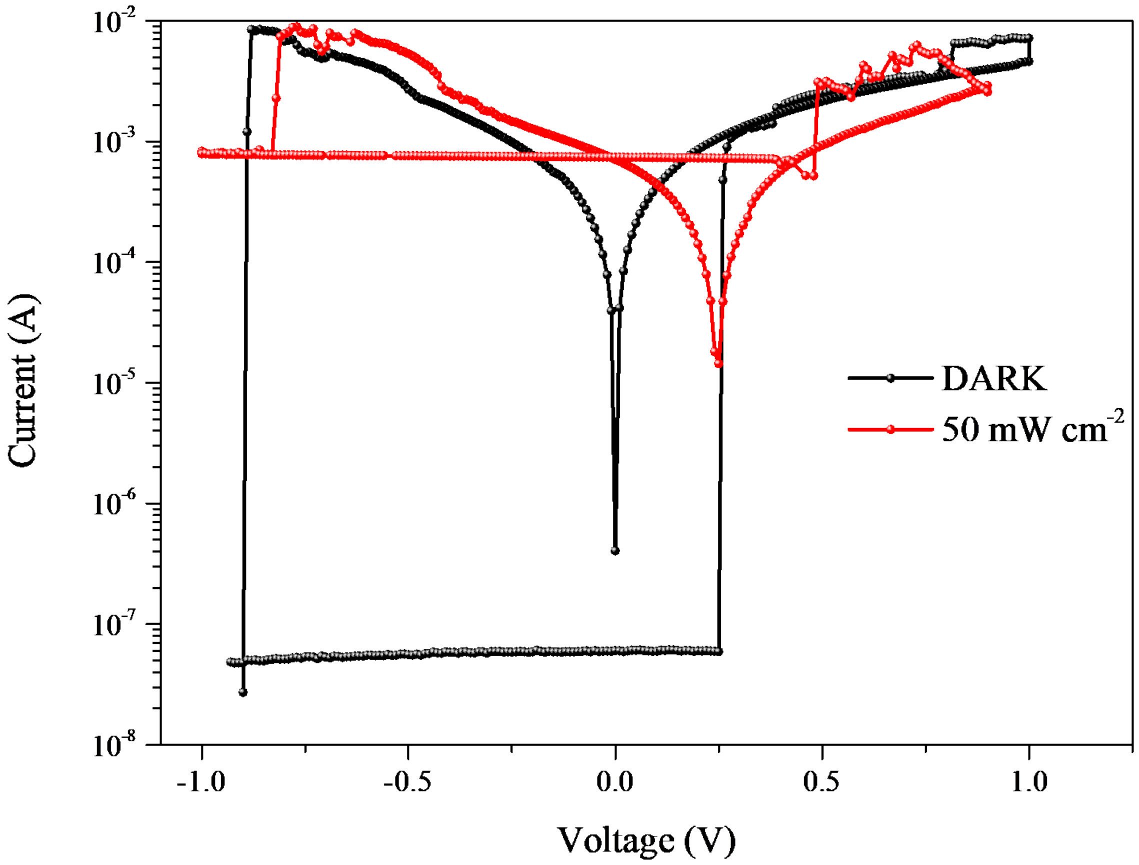


Figure S6. Multiple dc resistance switching loops for a) MemPVCell-1 and b) MemPVCell-2. I_{cc} of 10mA and a scanning rate of 100 mV s^{-1} were used.



Parameter (V)	Dark	Illuminated
Set Voltage	0.25	0.48
Reset Voltage	-0.9	-0.82

Figure S7. Influence of light illumination on the resistive switching behavior of MemPVCell -1. I_{cc}=10mA and a scanning rate of 100 mV s^{-1} were used.

Intensity (mW cm^{-2})	V_{SET} (V)	V_{RESET} (V)
8	0.20±0.04	-0.68±0.09
16	0.31±0.16	-0.62±0.06

Scan Rate mV s^{-1}	V_{SET} (V)	V_{RESET} (V)
50	0.17±0.01	-0.65±0.04
100	0.31±0.16	-0.62±0.06
300	0.37±0.14	-0.60±0.10

Table S5. a) Effect of Light Intensity at constant Scan Rate (100 mV s^{-1}), b) Effect of Scan Rate at Constant Illumination (16mW) for MemPVCell-1

Pulse Amplitude (V)	ON/OFF Ratio	Retention Time (s)
±1V	$1.26 \cdot 10^4$	$3.6 \cdot 10^3$
±2V	$1.90 \cdot 10^2$	$3 \cdot 10^3$

Table S6. ON/OFF ratio and retention time variation for ±2V pulse amplitude

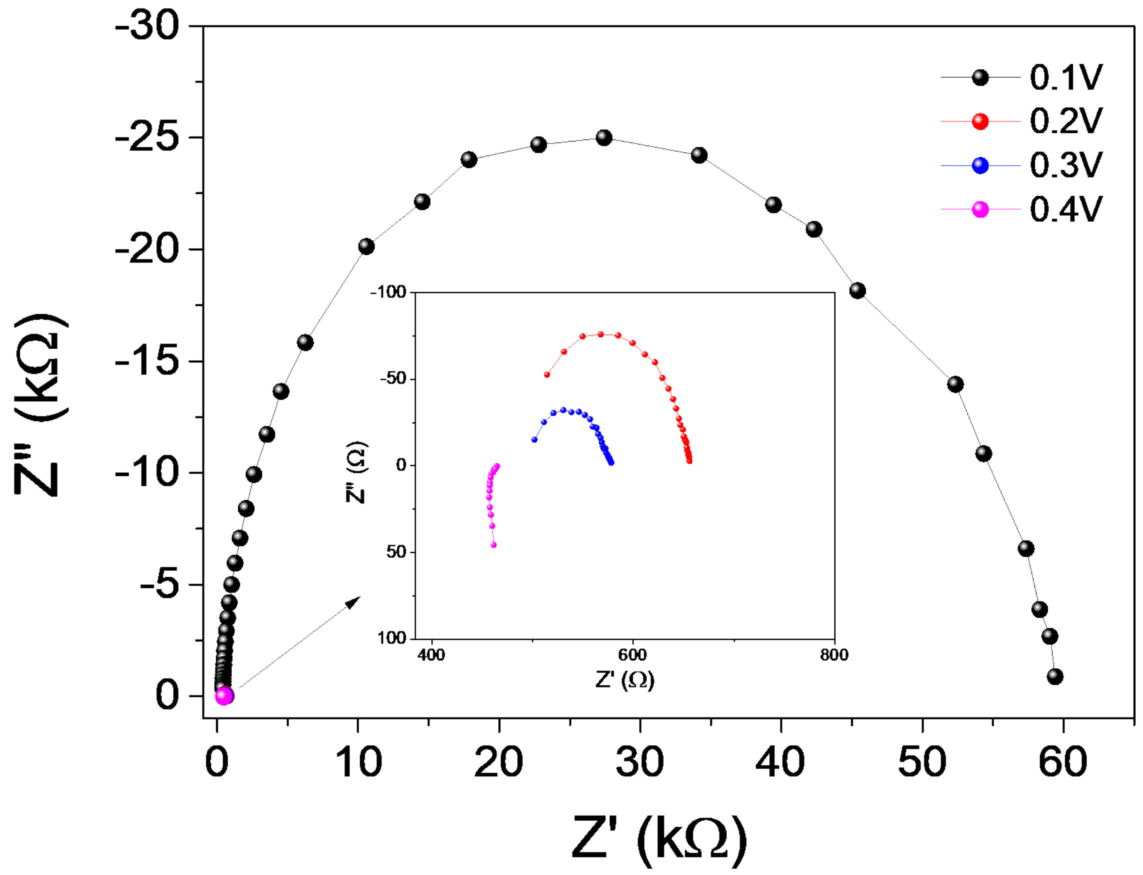


Figure S8. SET process of MemPVCell-1 achieved through impedance spectroscopy for increasing applied bias.

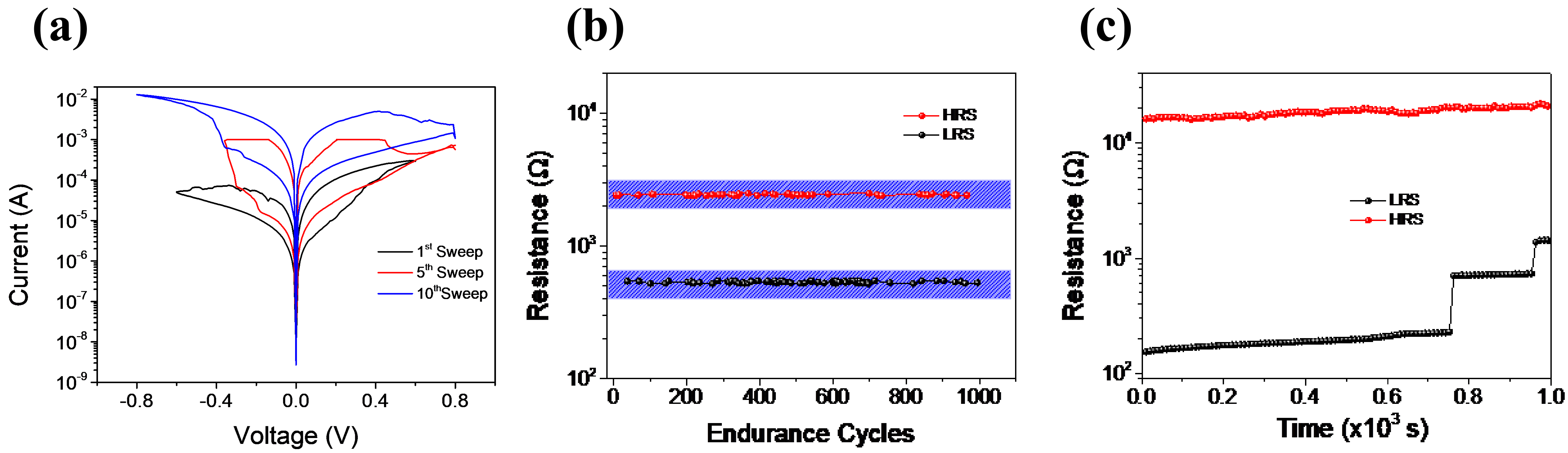


Figure S9. (a) dc Resistive switching behaviour, (b) endurance and (c) retention tests of the MemPVCell-3 (reference cell without PCBM). The following settings were used: (a) Scan from 0.8V to -0.8V with 100mV s^{-1} Scan Rate and Compliance Current I_{cc}=10mA (b) ,number of pulses up to 10^3, amplitude ±500mV, pulse duration 100ms. For resistance reading, a pulse with amplitude of 20mV and duration of 10ms was used. (c) Pulse Amplitude ±600mV, 500ms duration. Read pulse amplitude -20mV for 10ms duration every 10s.

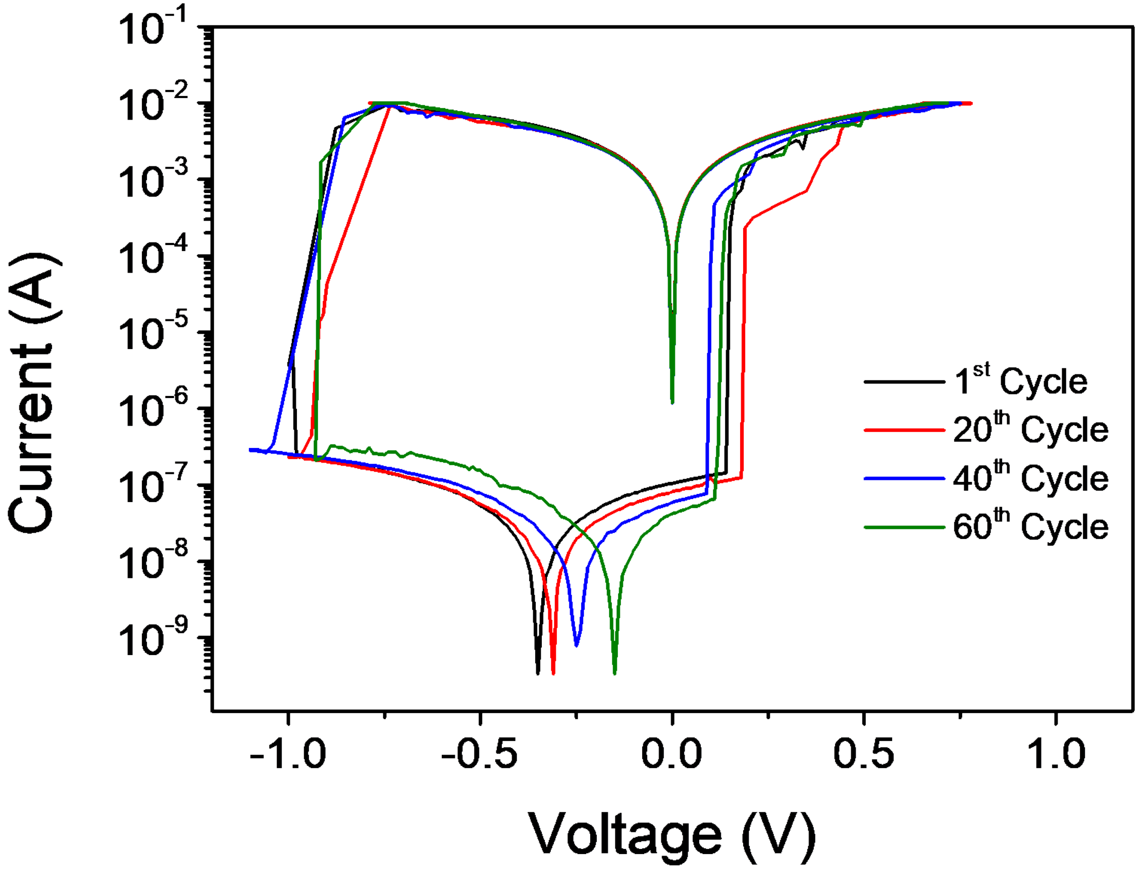


Figure S10. Resistive switching behaviour of the MemPVCell-4 (reference cell without PTAA)