Electronic Supplementary Material (ESI) for Nanoscale.

Supporting Information

Layered $(n\text{-}C_4H_9NH_3)_2CsAgBiBr_7$ Perovskite for Bipolar Resistive Switching Memory with High ON/OFF Ratio

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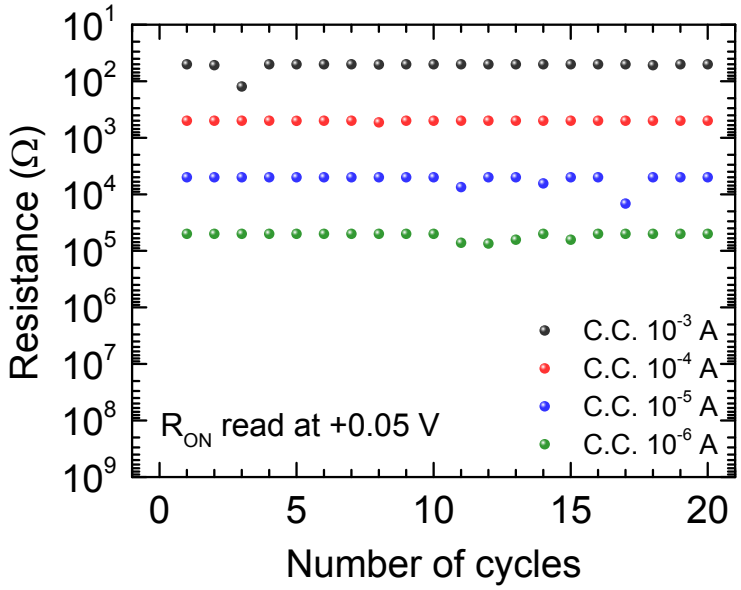

Figure S1. Resistance vs number of cycles with compliance current as a parameter for the $BA_2CsAgBiBr_7$ based memristor.

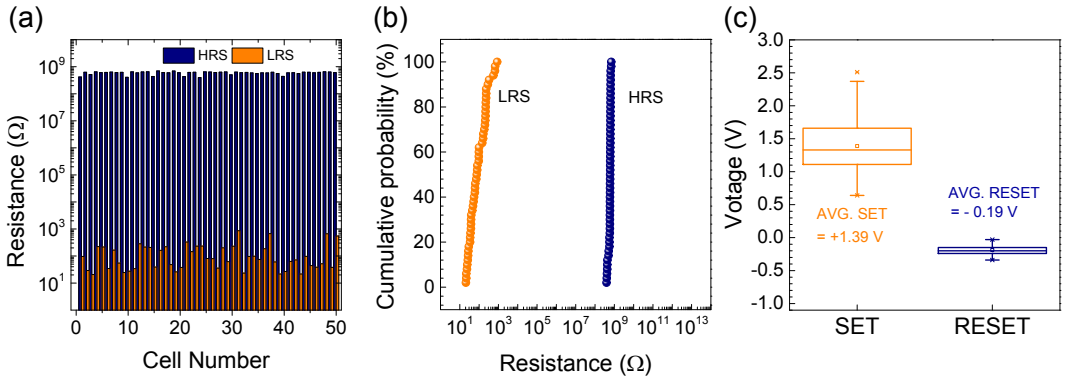

Figure S2. Reproducibility test of different 50 cells in one device. (a) The resistance values of HRS and LRS are read at the +0.02 V during DC voltage sweeps at the forming step. (b) Cumulative probability of the resistance values. (c) Statistical SET and RESET voltages. All sweeps in 50 cells were measured at the same applied voltages of +3.0 V for electroforming processes and -1.0 V for RESET processes.

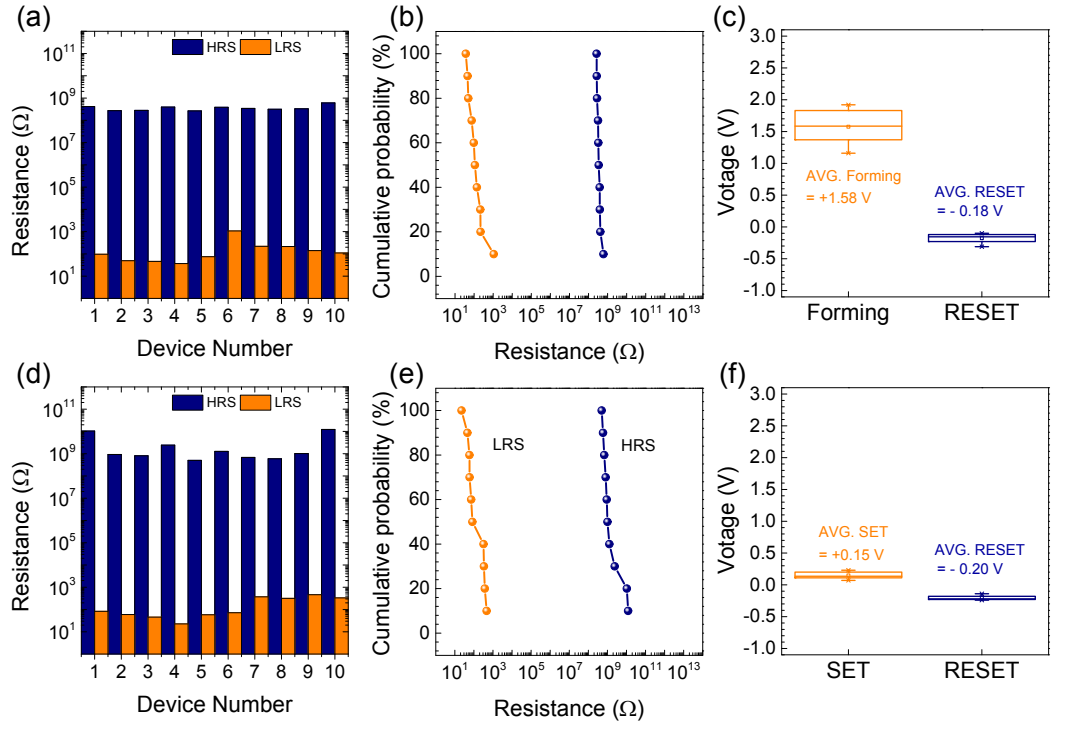

Figure S3. Reproducibility test of different 10 devices. (a-c) Forming process and (d-f) the next SET and REST processes. (a,d) The resistance values of HRS and LRS read at the +0.02 V during DC voltage sweeps. (b,e) Cumulative probability of the resistance values. (c,f) Statistical SET and RESET voltages. All sweeps in 10 devices were measured at the same applied voltages of +3.0 V for the forming process, +0.5 V and -0.1 V for the next SET and RESET processes.

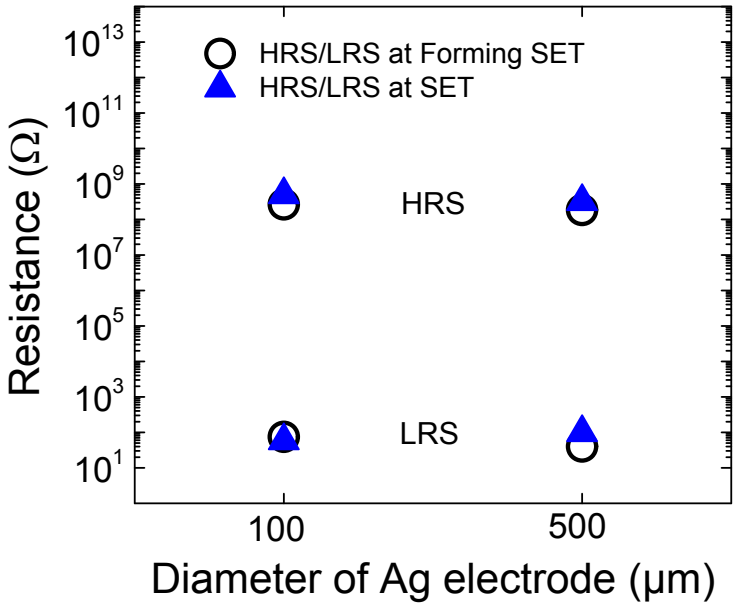

Figure S4. Dependence of HRS and LRS on the area of top Ag electrode. Black empty circles were read at +0.02 V at forming SET step and colored triangles at SET process after forming of the Ag/$BA_2CsAgBiBr_7$/Pt device.

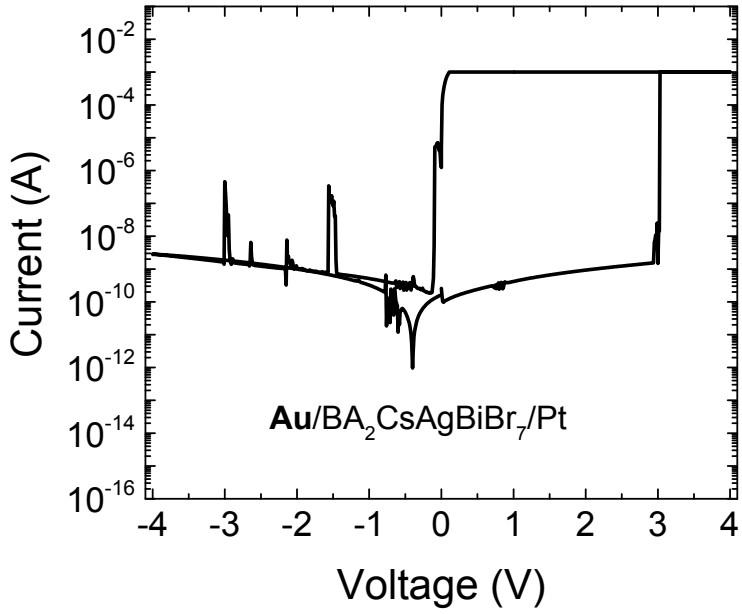

Figure S5. I-V characteristics of the $BA_2CsAgBiBr_7$-based device with an Au top electrode.

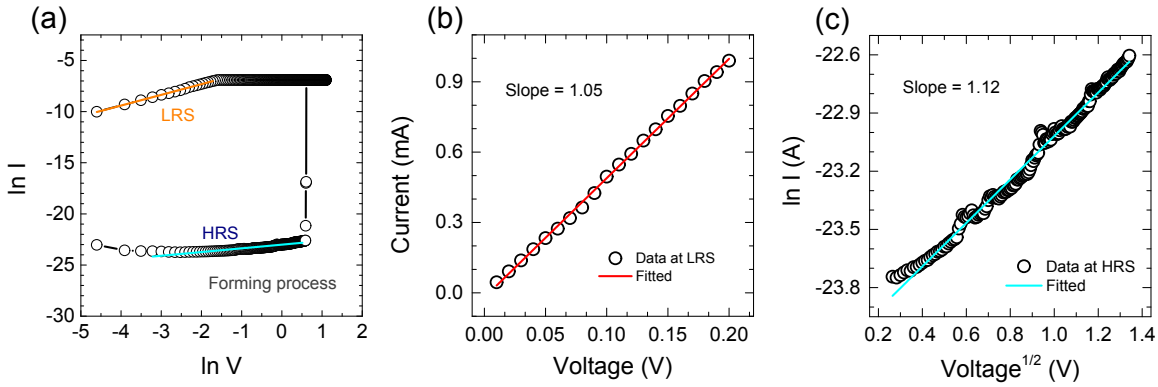

Figure S6. (a) Log-log plot of the I-V data for electroforming process. (b) I-V data for LRS, showing ohmic conduction. (c) I-V data for HRS, showing Schottky conduction.

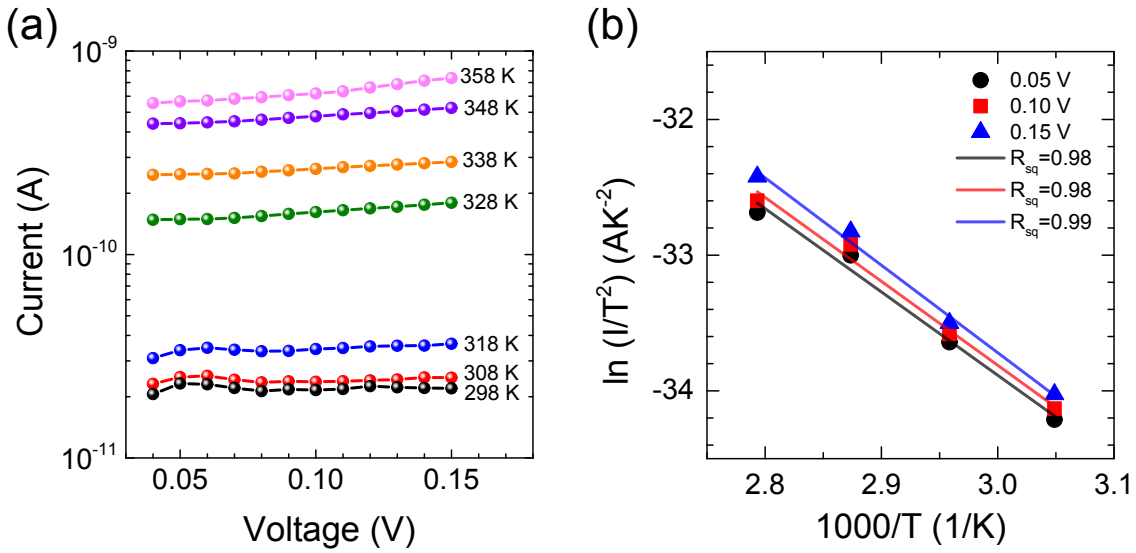

Figure S7. (a) Temperature-dependent HRS. (b) Linear fit of $\ln(I/T^2)$ versus 1000/T read at 0.05 V, 0.10 V and 0.15 V.

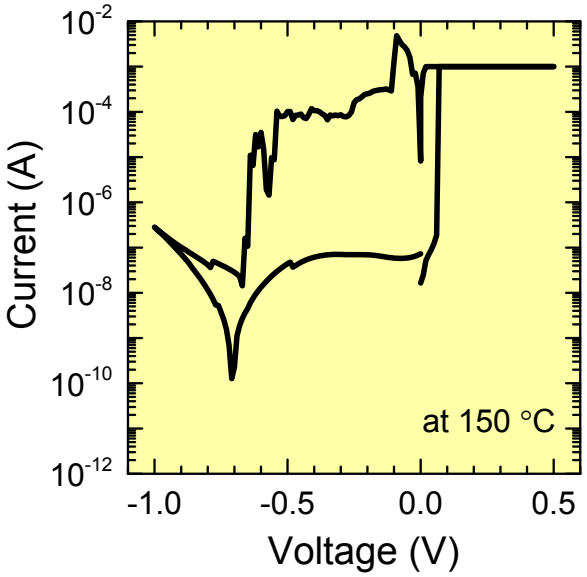

Figure S8. I-V characteristics of Ag/$BA_2CsAgBiBr_7$/Pt device at high temperature at 150 ^oC.

Table S1. Powder XRD data of $BA_2CsAgBiBr_7$

(*hkl*)	2 theta (degree)	d (Å)	I/I_0
001	4.55	19.4046	100
002	9.10	9.7099	2.8
003	13.66	6.4771	11.7
004	18.24	4.8597	7.7
005	22.86	3.8870	1.0
006	27.51	3.2396	19.8
007	32.21	2.7768	35.5
008	36.97	2.4295	7.0

Table S2. Comparison of memristive performance parameters of the current work with the reported lead-free halide perovskites.

Device Structure	SET/RESET voltage (V)	ON/OFF ratio	Retention (s)	Endurance	Ref.
$Ag/BA_2CsAgBiBr_7/Pt$	+0.13/ -0.20	$\sim10^7$	2×10^4	1000	This work
$Au/Cs_2AgBiBr_6/ITO$	+1.53/ -3.40	10^3	10^5	1000	[1]
$Au/Cs_3Bi_2I_9/ITO/PET$	+0.3/ -0.5	10^3	10^4	1000	[2]
$Au/Rb_3Bi_2I_9/Pt$	+0.09/ -0.48	10^7	10^3	200	[3]
$Au/Cs_3Bi_2I_9/Pt$	+0.1/ -0.63	10^6	10^3	400	[3]
$Ag/PMMA/CsSnI_3/Pt$	+0.13/ -0.08	7×10^3	7×10^3	600	[4]
$Au/PMMA/CsSnI_3/Pt$	+0.5/ -1.5	10^3	-	120	[4]
$Al/CsBi_3I_{10}/ITO$	-1.7/+0.9	10^3	10^4	150	[5]
$Au/MA_3Bi_2I_9/ITO$	+1.6/ -0.6	10^2	10^4	300	[6]
$Ag/PMMA/MA_3Sb_2Br_9/ITO$	-0.5/ +0.37	10^2	10^4	300	[7]
$Ag/PMMA/(BzA)_2CuBr_4/Pt$	+0.2/ -0.3	$\sim10^8$	10^3	~2000	[8]

References

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