

Achieving Adjustable Digital-to-Analog Conversion in Memristors with Embedded Cs₂AgSbBr₆ Nanoparticles

Supplementary Material

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KEYWORDS: lead-free double perovskites, nanoparticles, resistive switching memories, memristors, conductive filaments

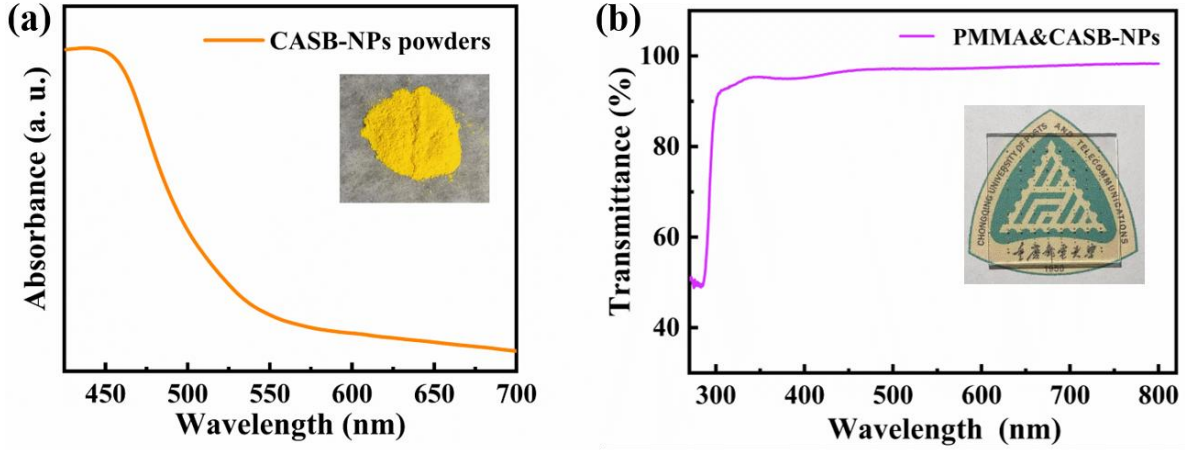


Fig. S1 (a) The absorption spectra of $\text{Cs}_2\text{AgSbBr}_6$ -NPs powders, the inset shows the optical image of the powders. (b) The transmission spectra of PMMA& $\text{Cs}_2\text{AgSbBr}_6$ -NPs film, the inset shows the optical image of the transparent $\text{Cs}_2\text{AgSbBr}_6$ -NPs memristor device.

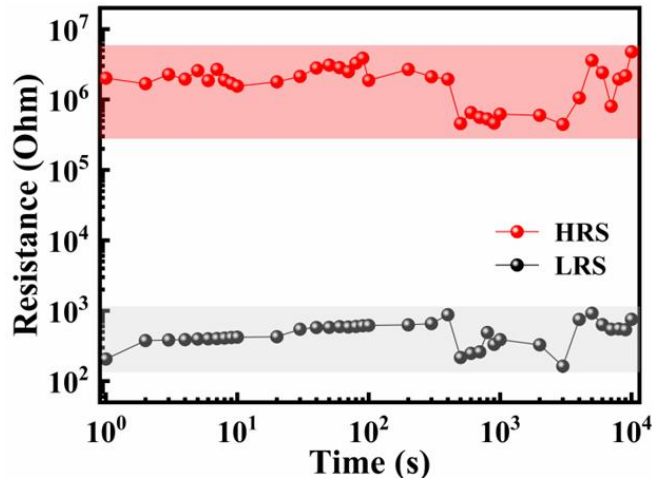


Fig. S2 The retention ability of Ag/PMMA& $\text{Cs}_2\text{AgSbBr}_6$ -NPs (5%)/ITO devices, the reading voltage is 0.1 V.

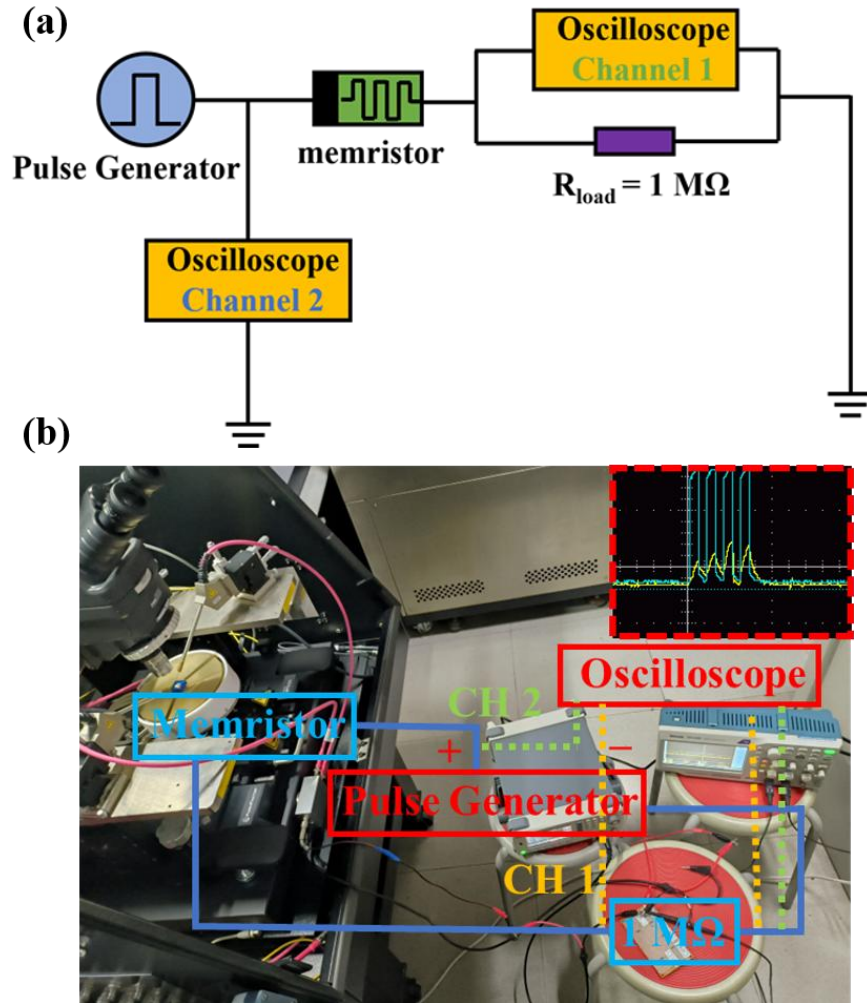


Fig. S3 (a) Schematic diagram of the artificial synaptic behavior measurement circuit. (b) The actual diagram of the test setup, the inset exhibits the waveform plot of artificial synapse measured from the oscilloscope.

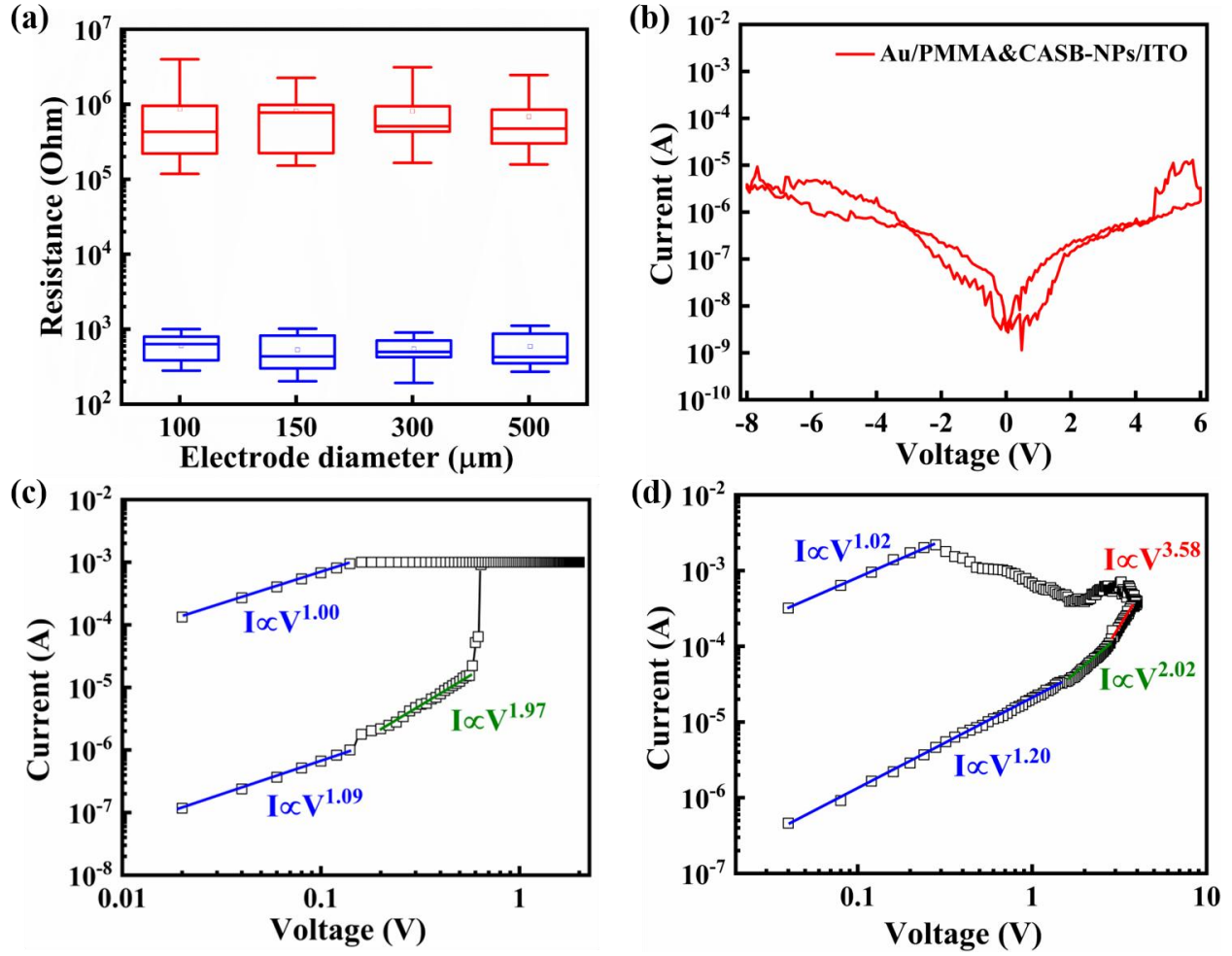


Fig. S4 (a) The dependence of the resistance states on the area of top Ag electrodes. (b) The I-V curve of the Au/PMMA&Cs₂AgSbBr₆-NPs/ITO memristor device. The fitting lines of typical I-V curve with log-log scale during (c) the positive bias-voltage and (d) the negative bias-voltage.

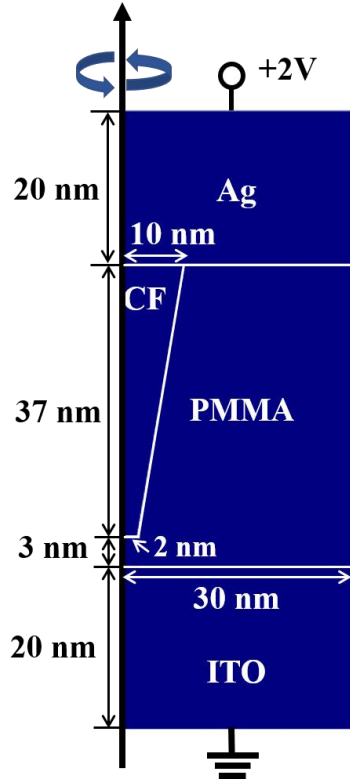


Fig. S5 The 2D axisymmetric model of the memristor in the simulation software. The $\text{Cs}_2\text{AgSbBr}_6$ -NPs are spheres with a diameter of 3 nm which are homogeneously added in the PMMA layer.

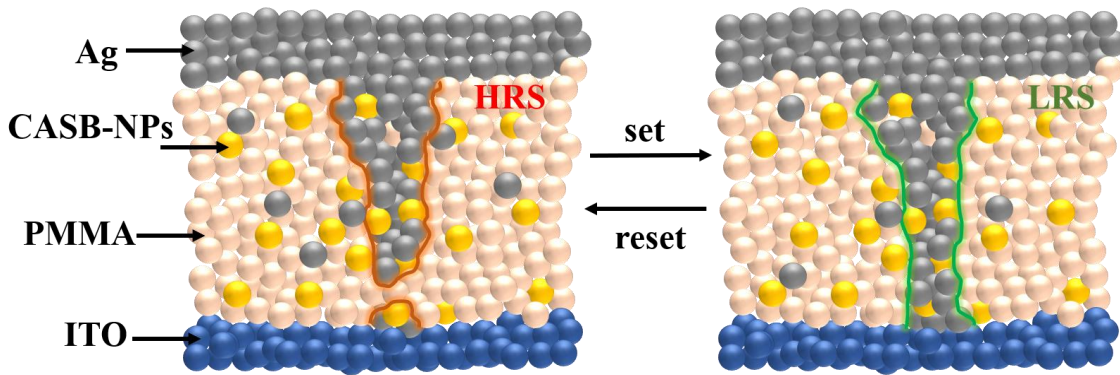


Fig. S6 Schematic diagram of the formation and rupture of Ag-conducting filaments.

Table S1. Comparison of the Ag/PMMA&Cs₂AgSbBr₆-NPs/ITO memristor with previously reported memristors. (* indicates that the data is read from the graph)

Structures	Type	Reset/Set voltage (V)	Endurance cycles	Retention time (s)	PPF index	Ref
Ag/PMMA/AgBiI ₄ //ITO	Digital	-0.16/+0.16 V	700	10 ⁴	--	1
Al/CsBi ₃ I ₁₀ /ITO	Digital	-1.7/+0.9 V	150	10 ⁴	--	2
Ag/PMMA/Cs ₃ Cu ₂ I ₅ /ITO	Digital	-0.44/+0.60 V	100	10 ⁴	--	3
Ag/CsSnCl ₃ /ITO	Digital and Analog	-1.07/+0.95 V	10 ⁵	10 ⁴	12%*, Δt=10 μs	4
Ag/PMMA/Cs ₂ AgBiBr ₆ /ITO	Digital and Analog	-0.5/+0.5 V	110	10 ³	30%, Δt=0.2 ms	5
Au/CsCu ₂ I ₃ /ITO	Analog	+0.2/-1.2 V	--	--	52%*, Δt=10 ms	6
Ag/PMMA&Cs ₂ AgSbBr ₆ -NPs/ITO	Digital and Analog	-0.42/+0.67 V	900	10 ⁴	25.7%, Δt=10 μs	This work

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