Supporting Information

Air-stable Artificial Synapse Based on Lead-free Double Perovskite $Cs_2AgBiBr_6$ Film for Neuromorphic Computing

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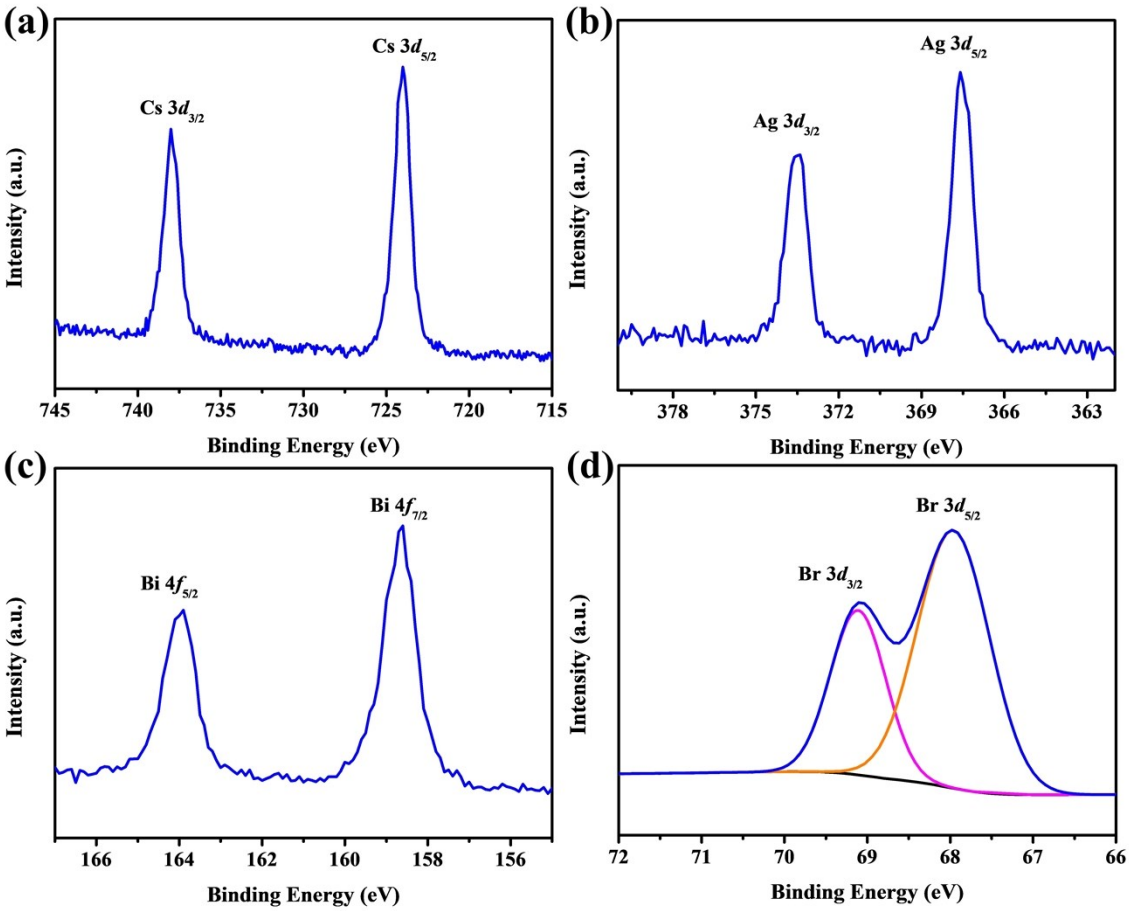

Figure S1. XPS spectrum of $Cs_2AgBiBr_6$ film (a) Cs; (b) Ag; (c) Bi and (d) Br elements.

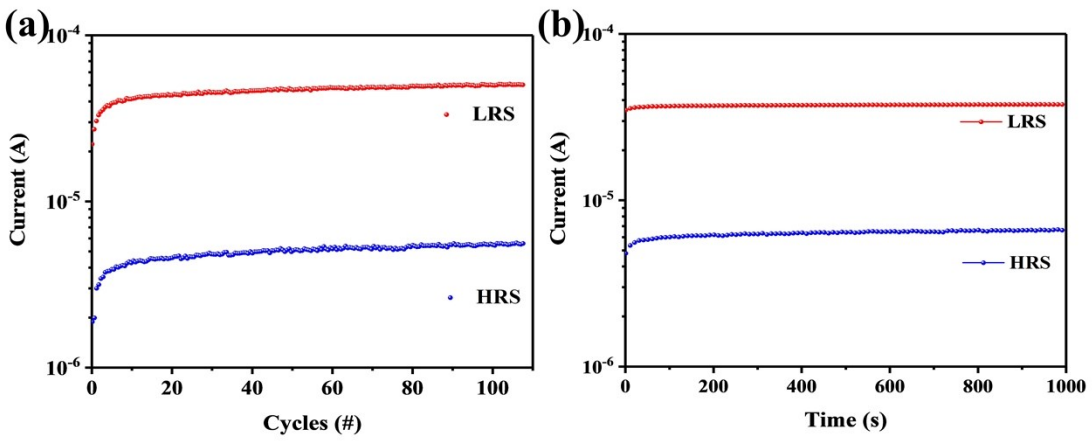

Figure S2 (a) Endurance read at 0.1 V extracted from 110 "writing" and "erasing" cycles and (b) retention read at 0.1 V for the Ag/PMMA/$Cs_2AgBiBr_6$/ITO device.

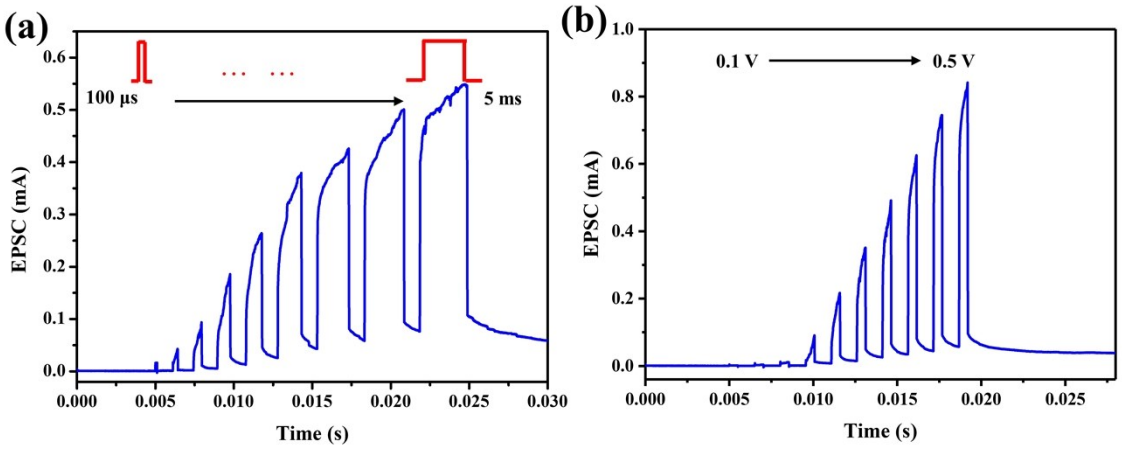

Figure S3. EPSC triggered by (a) different pulse widths (0.1 ms ~ 5 ms) and (b) different voltage bias (0.1 ~ 0.5 V) on $Cs_2AgBiBr_6$-based device.

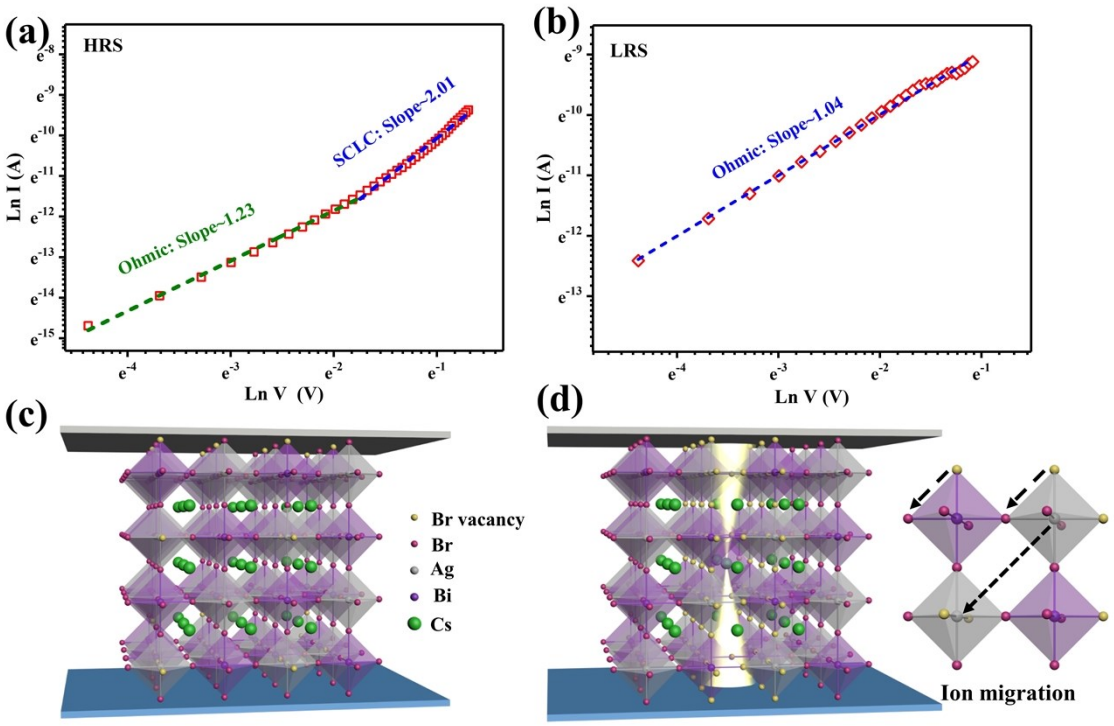

Figure S4. Conduction mechanism of the $Cs_2AgBiBr_6$-based memristor. The ln I−ln V with linear fitting in (a) HRS and (b) LRS. Schematic diagram of (c) initial state and (d) formation of conductive filaments caused by $Br^-$and Ag^+ ion migration.

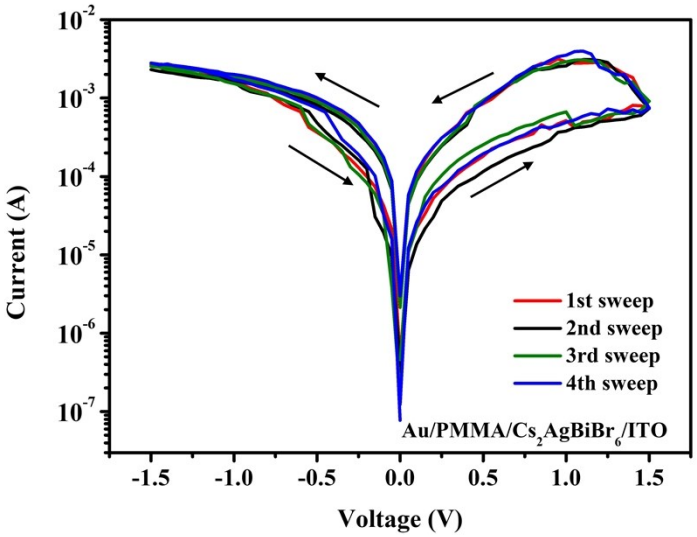

Figure S5. The *I-V* curves of the Au/PMMA/$Cs_2AgBiBr_6$/ITO device.

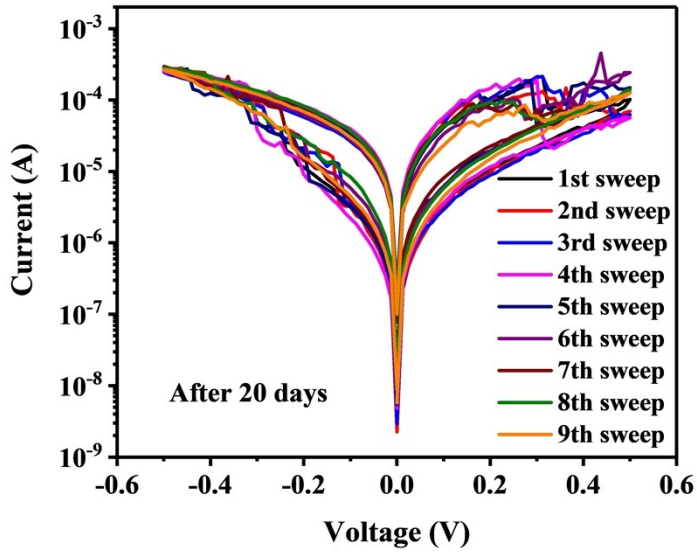

Figure S6. The *I-V* curves of $Cs_2AgBiBr_6$-based device after storing in air environment for 20 days.

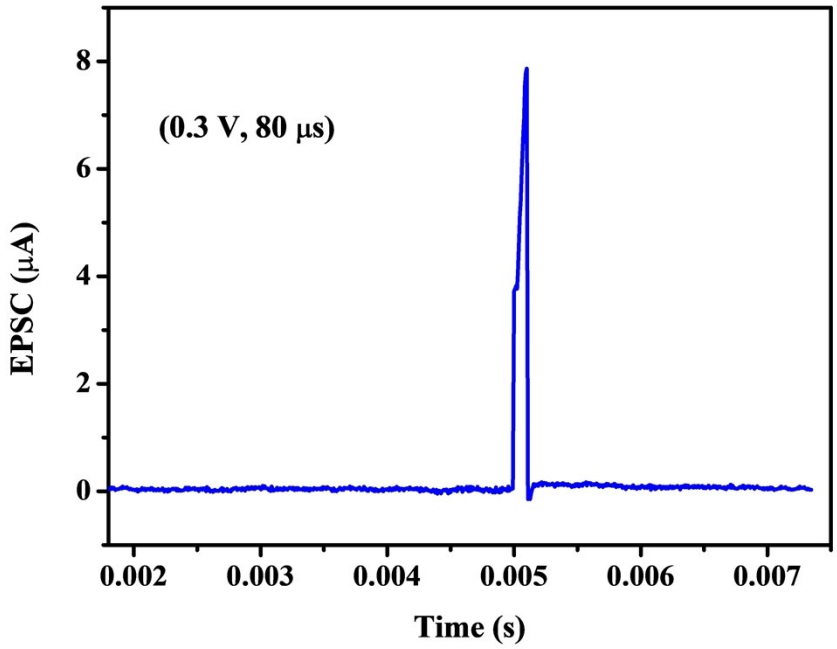

Figure S7. EPSC triggered by an electrical pulse with an amplitude of 0.3 V and a width of 80 μs. (A voltage pulse with an applied voltage amplitude of 0.3 V and a pulse width of 80 μs triggered an EPSC of 7.86 μA, resulting in an energy consumption of 188.6 pJ. The energy consumption was calculated according to the equation: $E = V \times I \times t$, where V, I, and t represent the pulse amplitude, EPSC peak value and pulse width, respectively.)

Table S1. Synaptic plasticity of the perovskite memristor-based artificial synapses.

Structure	Set/reset voltage (V)	Retention Time (s)	Energy consumption (J)	Air stability	Ref
Ag/PMMA/$Cs_3Cu_2I_5$/ITO	+1/-1	10^4	≈2.8×10^{-11}	\	ACS Appl. Mater. Interfaces, 2020, 12, 23094
Ag/PMMA/$(Cs_3Bi_2I_9)_{0.4}$-$(CsPbI_3)_{0.6}$/Pt	+0.6/-0.6	10^4	\	30 days	Adv. Funct. Mater., 2019, 29, 1906686
Au/$Cs_3Sn_2Br_9$/Au	+2/-2	\	≈19×10^{-11}	\	Nano Energy, 2020, 71, 104616
Al/$MAPbClBr_2$/Si	\	\	≈5×10^{-10}	\	Mater. Chem. Front., 2019, 3, 941-947
Au/$CsPbBr_3$/CuSCN/PEDOT:PSS/ITO/	+1.5/-1.5	\	16×10^{-4}	\	Adv. Funct. Mater., 2020, 30, 1908901
Au/$MAPbI_3$/Au	0.5	\	≈1.25×10^{-7}	\	ACS Nano, 2018, 12, 1242−1249
Si/SiO_2/Ti/Pt/$CH_3NH_3PbI_3$/Au	+2/-1.5	10^5	\	\	Adv. Mater. 2017, 29, 1701048
Au/$MAPbBr_3$ SCTP/Au	\	\	20×10^{-15}	\	Adv. Funct. Mater. 2020, 30, 2005413
Ag/PMMA/$Cs_2AgBiBr_6$/ITO	**+0.5/-0.5**	**10^3**	**18×10^{-11}**	**20 days**	**This work**