Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Support Information

High performance perovskite memristor by integrating tip shape contact

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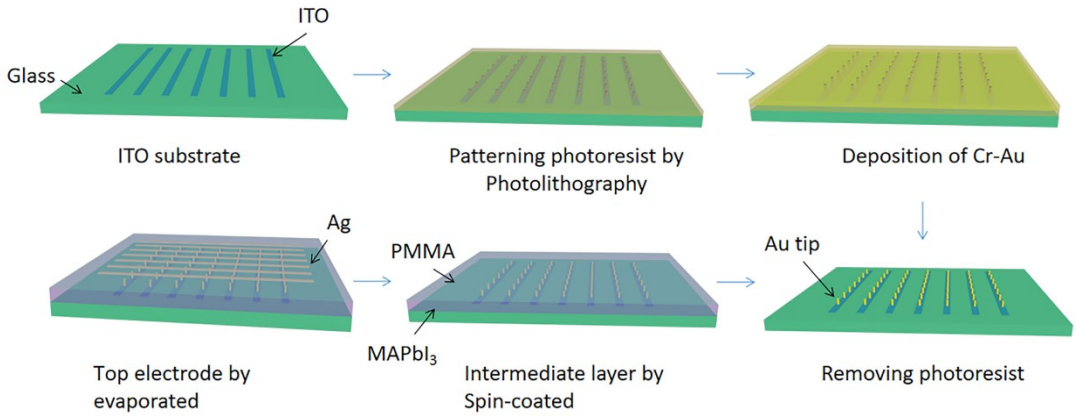

Figure S1. Schematic diagram showing the basic fabrication process of Ag/PMMA/$MAPbI_3$/Au tip/ITO RRAM device.

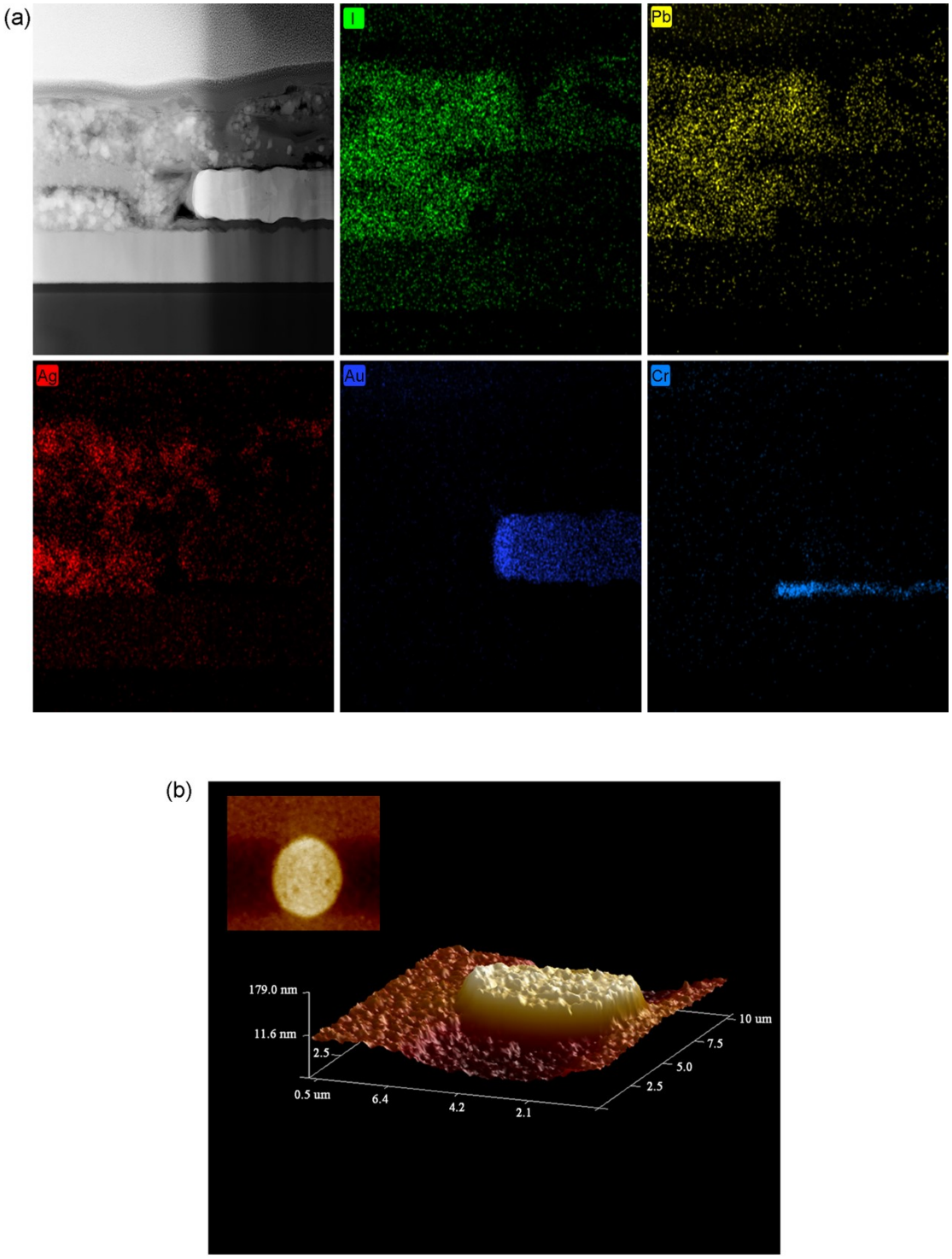

Figure S2. (a) TEM image and EDS mapping of Ag/PMMA/$MAPbI_3$/Au tip/ITO structure at the interface in the initial state. (b) AFM image of the Au tip structure on the ITO substrate.

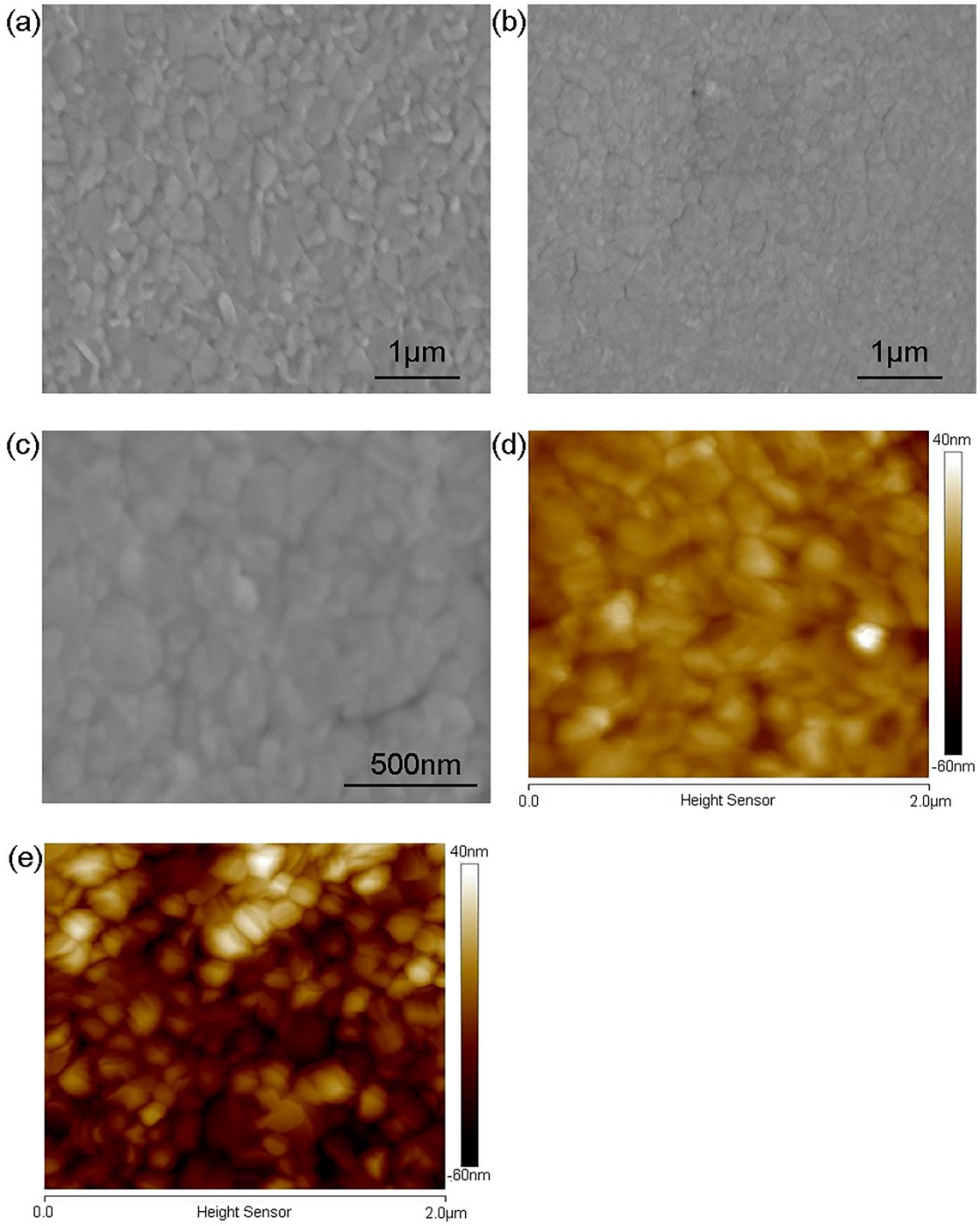

Figure S3. (a) Top-view FESEM image of the $MAPbI_3$ perovskite film with PMMA. (b-c) Top-view FESEM image of the $MAPbI_3$ perovskite film without PMMA. (d) AFM image of the $MAPbI_3$ perovskite film with PMMA.(e) AFM image of the $MAPbI_3$ perovskite film without PMMA.

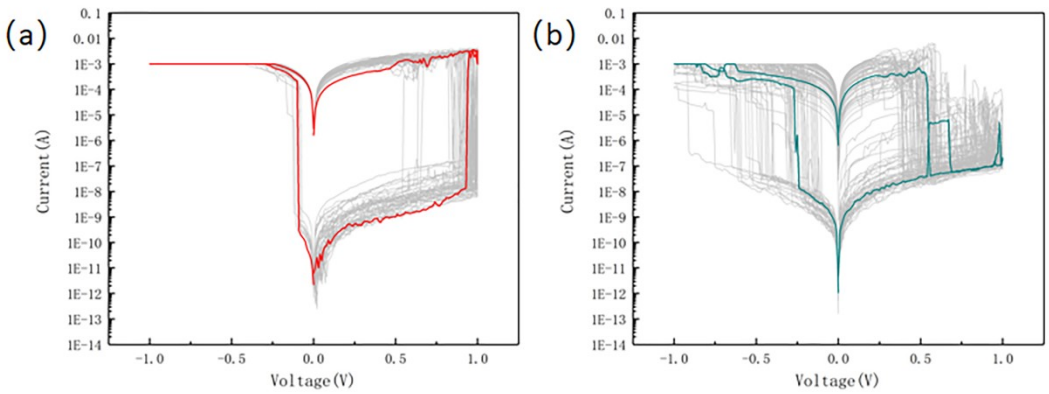

Figure S4. (a) *I-V* curves of Ag/PMMA/$MAPbI_3$/Au tip/ITO RRAM device in the flat state over 50 consecutive cycles. (b) *I-V* curves of Ag/PMMA/$MAPbI_3$/ITO RRAM device in the flat state over 50 consecutive cycles.

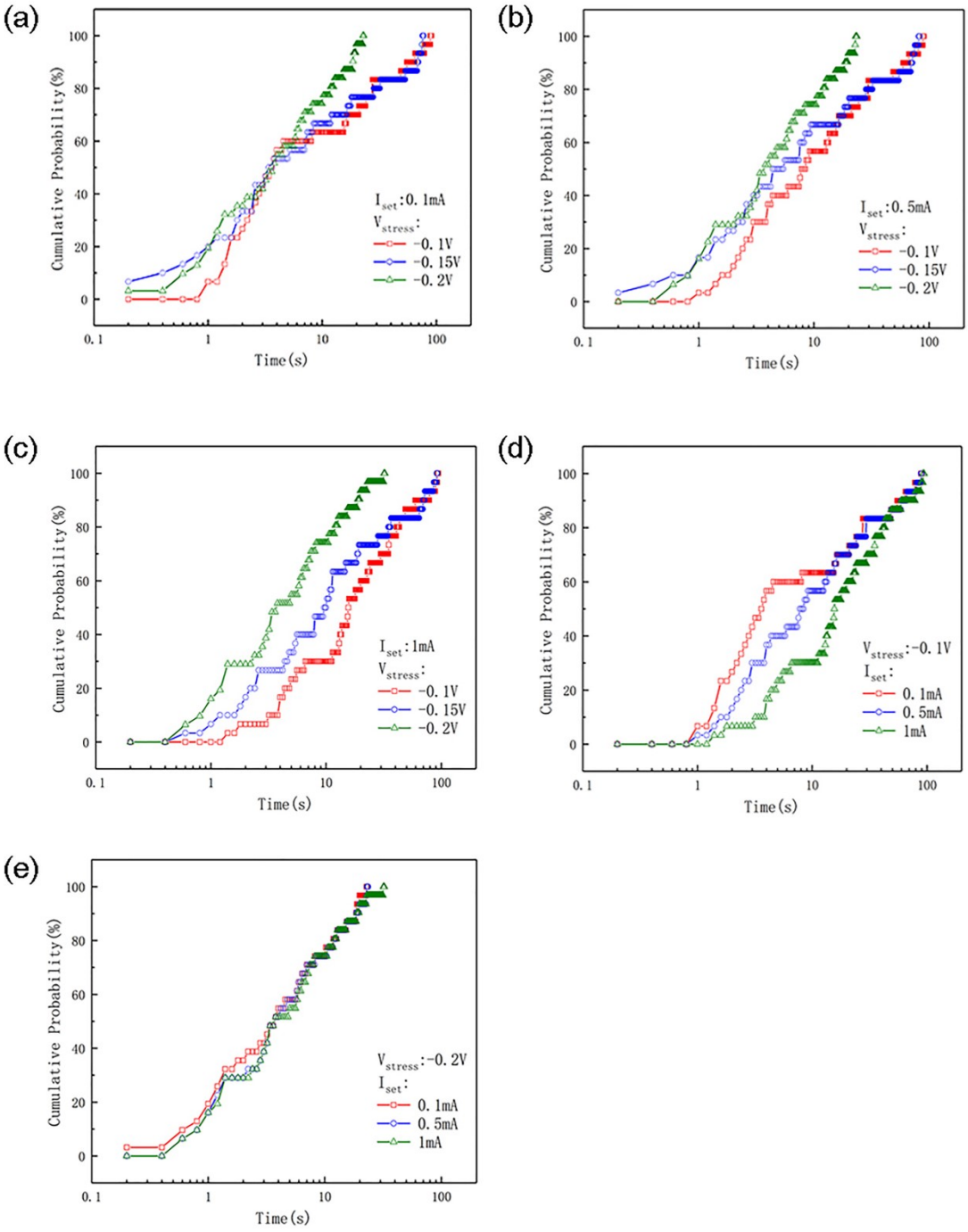

Figure S5. The cumulative probability of $t_{turn\text{-}on}$ values under different V_{Stress} (from -0.1 V to -2 V) according to different I_{CC}. (a) 0.1 mA, (b) 0.5 mA, (c) 1 mA. The cumulative probability of $t_{turn\text{-}on}$ values under different I_{CC}(from 0.1 mA to 1 mA) according to different V_{Stress}. (d) -0.1 V and (e) -0.2 V.

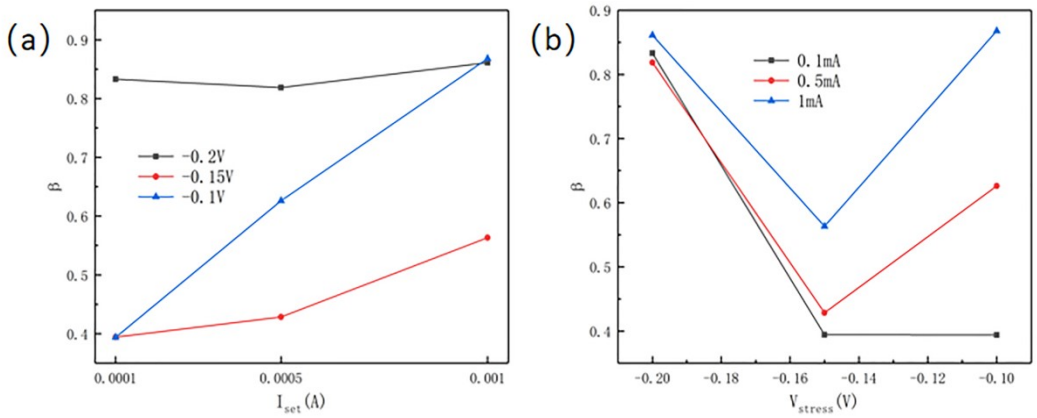

Figure S6. The variation of *β* for different (a) I_{CC} and (b) V_{Stress}.

Material	Density ($kg \cdot m^{-3}$)	Electrical conductivity ($S \cdot m^{-1}$)
Au	19320	2.00E-07
$MAPbI_3$	316	3.00E-07
PMMA	1150	5.00E-09
Ag	10490	3.00E-08

Table S1. Detailed parameters used for the simulations presented in Figure 4.

$$J = \sigma E$$
$$E = -\nabla V$$

Here, J is the current density, σ is the electrical conductivity, E is the electric field, and V is the electric potential. The applied voltage is -1 V. (Parameters used for the simulation were from the material library of COMSOL Multiphysics.)

Material	Size (um)	Height (um)
Au tip	3 (Radius)	0.2
$MAPbI_3$	500×500	0.3
PMMA	500×500	0.01
Ag	500×500	0.03

Table S2. Detailed geometric parameters used for the simulations presented in Figure 4.

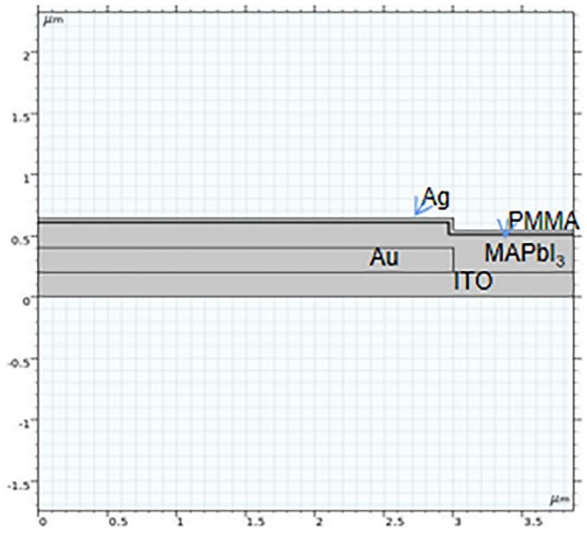

Figure S7. The distribution of the layer along the distance from the central point.

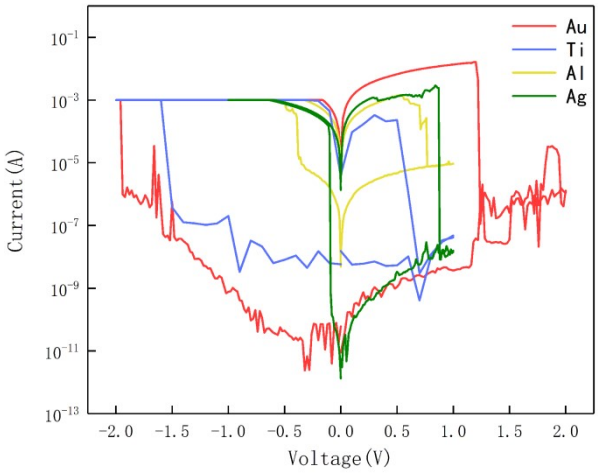

Figure S8. The I-V curves of different top electrodes (Au, Ti, Al, Ag) on the tip device.

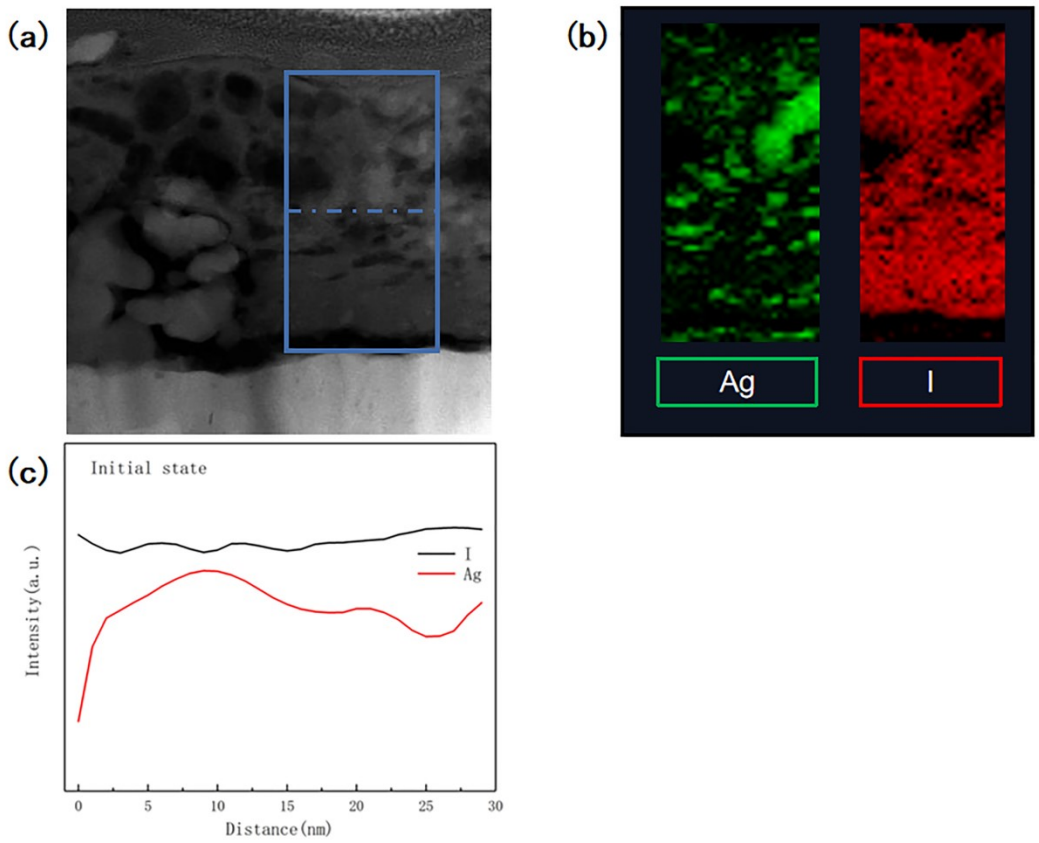

Figure S9. (a-b) TEM image and EELS mapping of Ag/PMMA/$MAPbI_3$/Au tip/ITO in HRS.

(c) Elementary composition varied with distance along the scan line in (a).

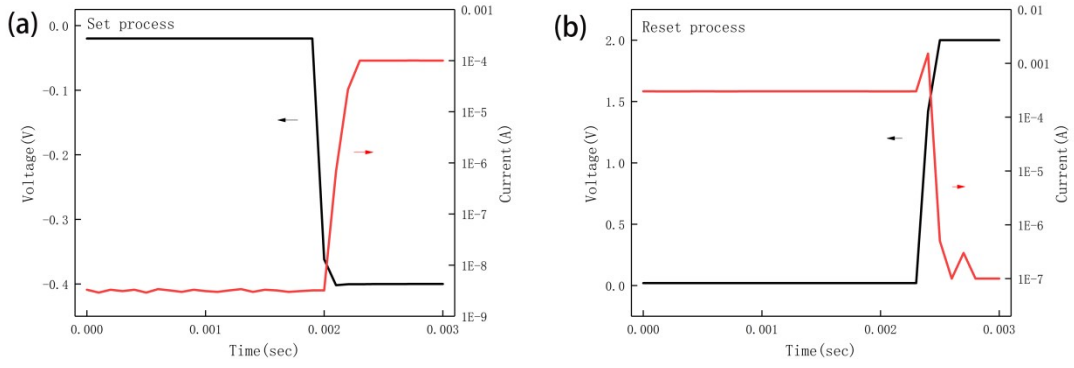

Figure S10. The response time of the tip RRAM device. The response times for SET and RESET operations were about (a) 300 μs and (b) 200 μs, respectively.