Electronic Supplementary Material

Capping $CsPbBr_3$ with ZnO to improve performance and stability of perovskite memristors

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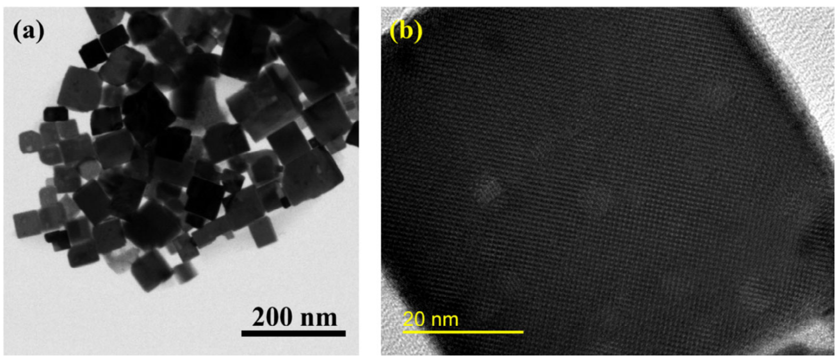

Figure S1 (a) TEM image of the room temperature processed nanoparticles. (b) HRTEM image of a single particle, which exhibits high crystallinity.

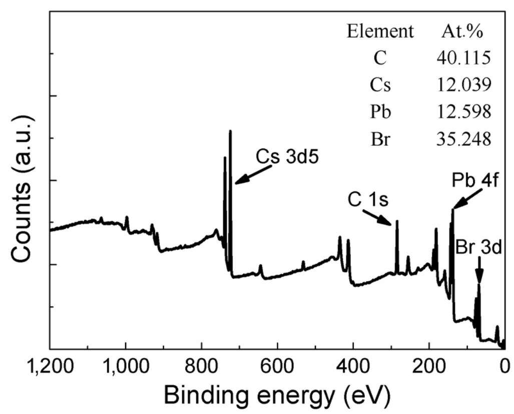

Figure S2 XPS survey spectrum of $CsPbBr_3$. The inset shows the atomic ratio of corresponding elements that the particles are stoichiometric.

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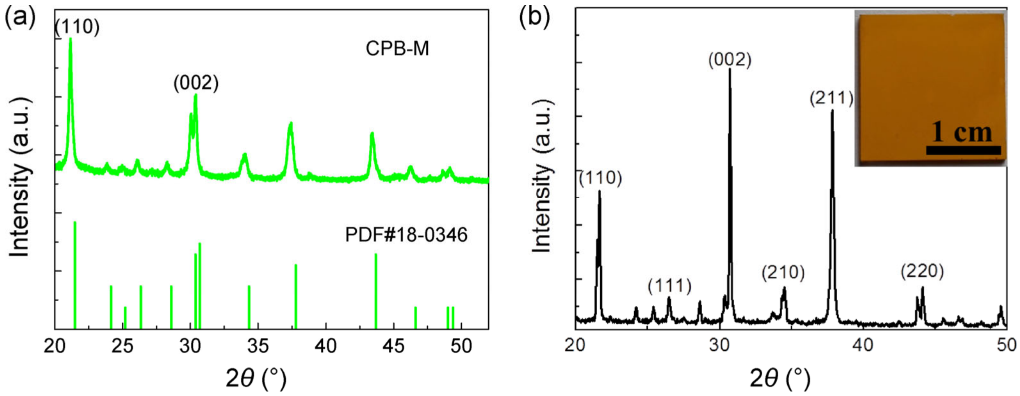


Figure S3 (a) XRD pattern of randomly aggregate nanoparticles. (b) XRD pattern of the as-deposited film after treating. The inset shows the graph of corresponding sample.

Discussion

Based on the XRD pattern, the $CsPbBr_3$ film exhibits preferential assembly along (002) planes during the film-forming process under centrifugal force even after treating. To demonstrate the assemble degree of the NC film, we calculate the texture coefficient (TC) according to following equation

$$\mathrm{TC}_{002}=\frac{I_{002}/I_{002}^{0}}{I_{002}/I_{002}^{0}+I_{110}/I_{110}^{0}}$$

where TC_{002} is the relative texture coefficient of diffraction peaks (002) over (110), I_{002} and I_{110} are the measured diffraction intensities of (002) and (110) planes while I_{002}^{0} and I_{110}^{0} are values from standard PDF data (NO. 18-0364). The TC_{002} of the assembled film and powder (Fig. S3) are 0.73 and 0.52 respectively. The relatively higher value of TC_{002} of the NC film indicates the textured and well-aligned features. Importantly, assemble film usually exhibit high dense and low smooth, which is beneficial for optoelectronic and electronic devices.

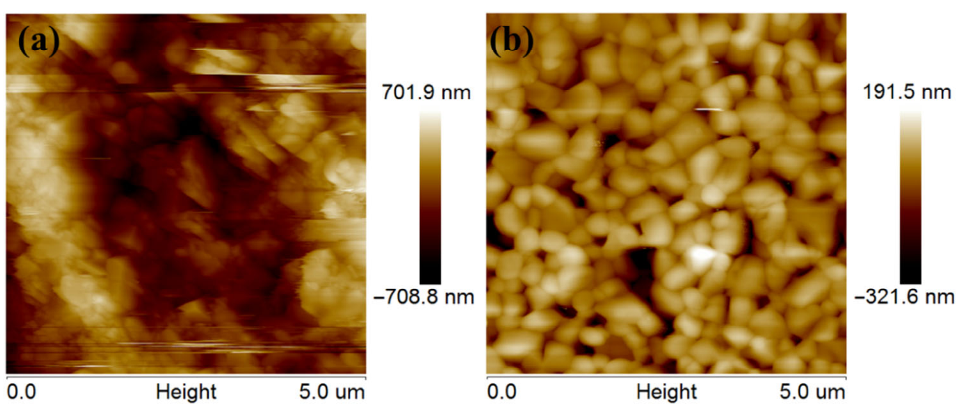


Figure S4 AFM images of (a) untreated and (b) treated $CsPbBr_3$ films. The roughness of the assembled perovskite film is less than 300 nm, which confirms the relative high dense and low roughness film compared to untreated films.

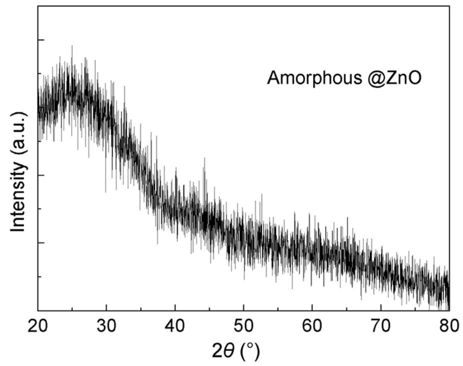


Figure S5 XRD pattern of the ZnO film on FTO/glass substrate, exhibiting an amorphous feature.

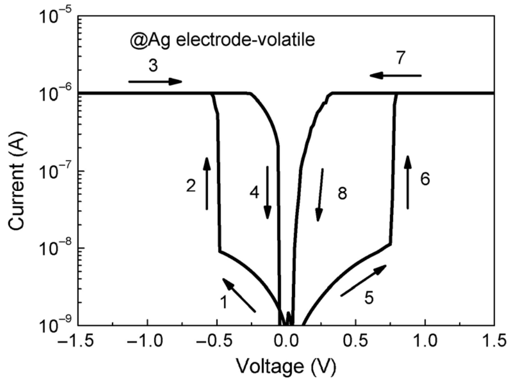


Figure S6 A typical *I*–*V* curve of a device with Ag as the top electrode. Unfortunately, all the devices exhibit volatile behavior, which might result from the reaction of Ag and perovskite.

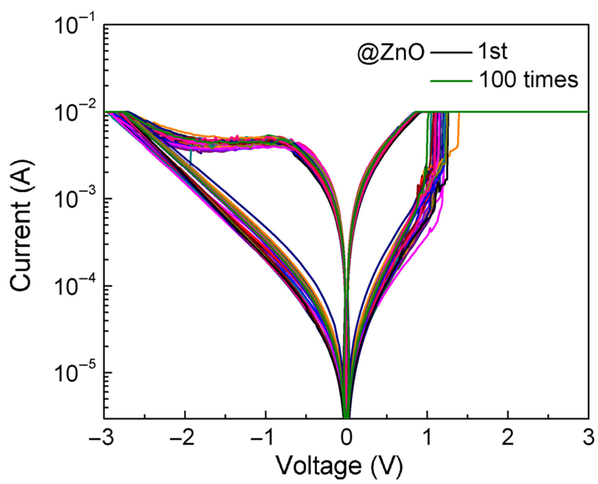


Figure S7 *I*–*V* curves of the device with only amorphous ZnO film (~100 nm). This device shows better reproducible and reliable nonvolatile memory for more than 100 cycling times.

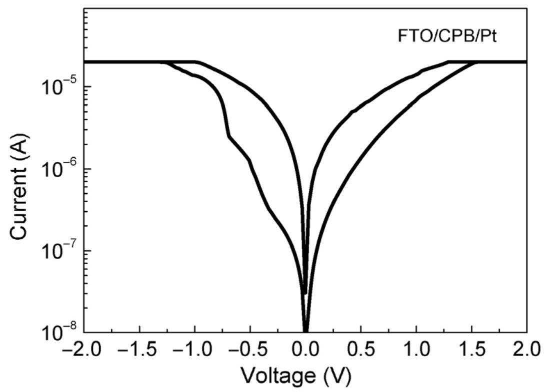


Figure S8 Typical *I–V* curve of FTO/CPB/Pt device. Though there is an obvious resistance switching behavior, the change is not instantaneous and the on/off ratio is very small.

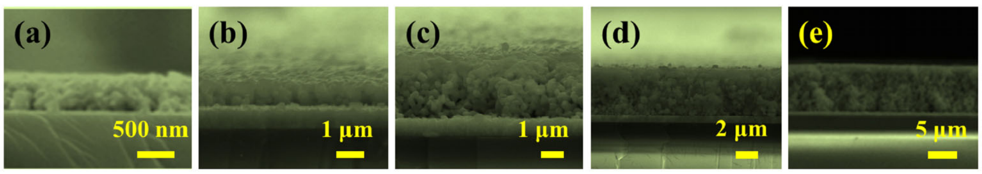


Figure S9 Cross-sectional SEM images of CPB films with different thicknesses. Obviously, the thickness can be tuned randomly over a wide range through concentration controlling of dispersions for centrifugal casting.

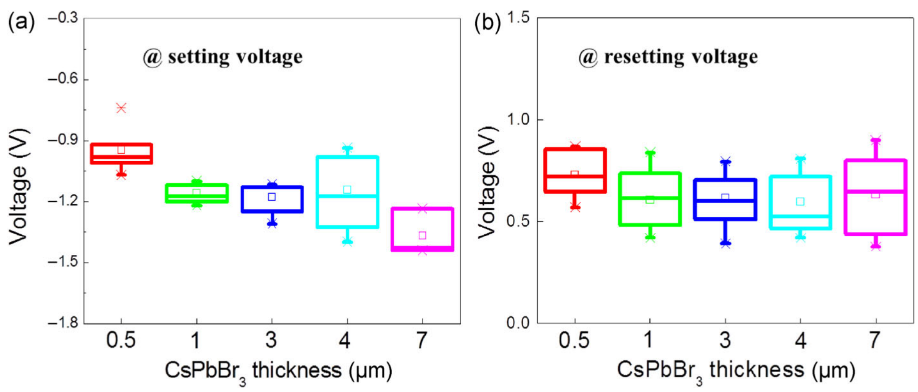


Figure S10 (a) Set and (b) reset voltages as a function of perovskite film thickness. One can see that the setting voltage becomes larger with the increase of thickness while resetting voltage is relatively independent on thickness.

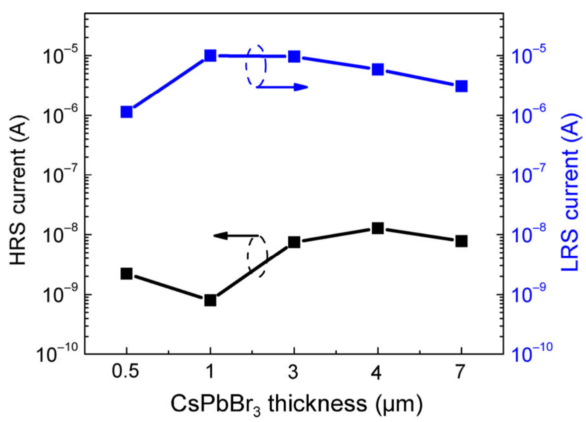


Figure S11 HRS and LRS current as a function of CPB film thickness.

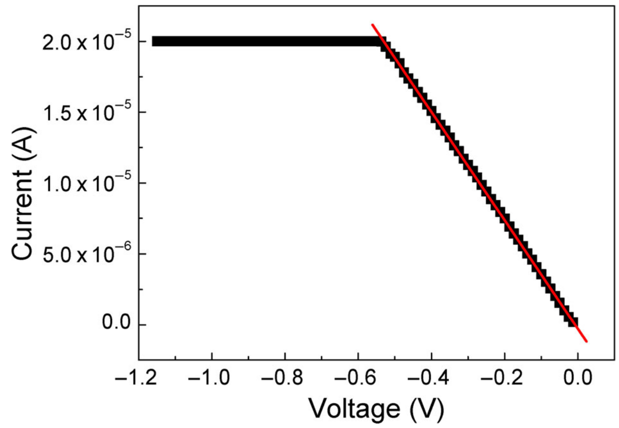


Figure S12 *I–V* curve of LRS at the negative region for FTO/CPB/ZnO/Ni device, which shows a good linear relationship.

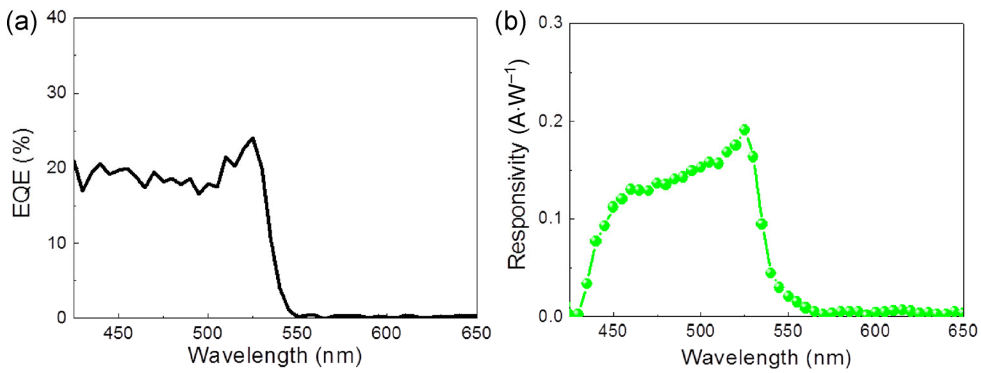
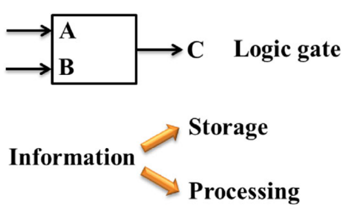


Figure S13 EQE (a) and responsivity (b) spectra of the device, respectively. The external quantum efficiency (EQE) and responsivity versus wavelength at 0 V are shown that the maximum EQE value at 524 nm reaches 25% with a high responsivity of ~0.2 A·W^{-1}.



Signal	Input A (light)	Input B (electricity)	Output C
1	1 **(on)**	1 **(high)**	1
2	0 **(off)**	0 **(low)**	0
3	1 **(on)**	0 **(low)**	1
4	0 **(off)**	1 **(high)**	1

Figure S14 Working mechanism of the logic device.