

Supporting information

Performance improvement of resistive switching memory achieved by reducing the size of MoS₂ embedded in poly(vinyl alcohol) films

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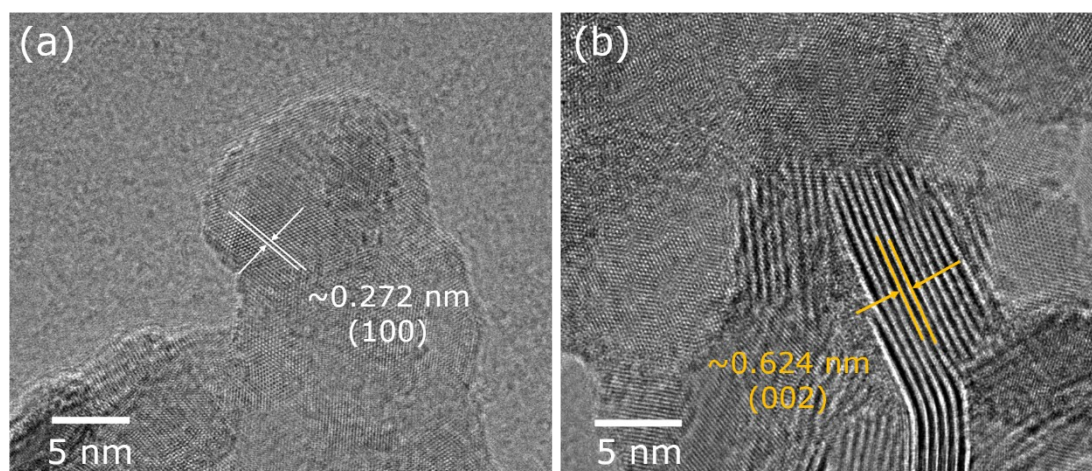


Fig. S1 High-resolution transmission electron microscopy (HRTEM) images of MoS₂ nanosheets.

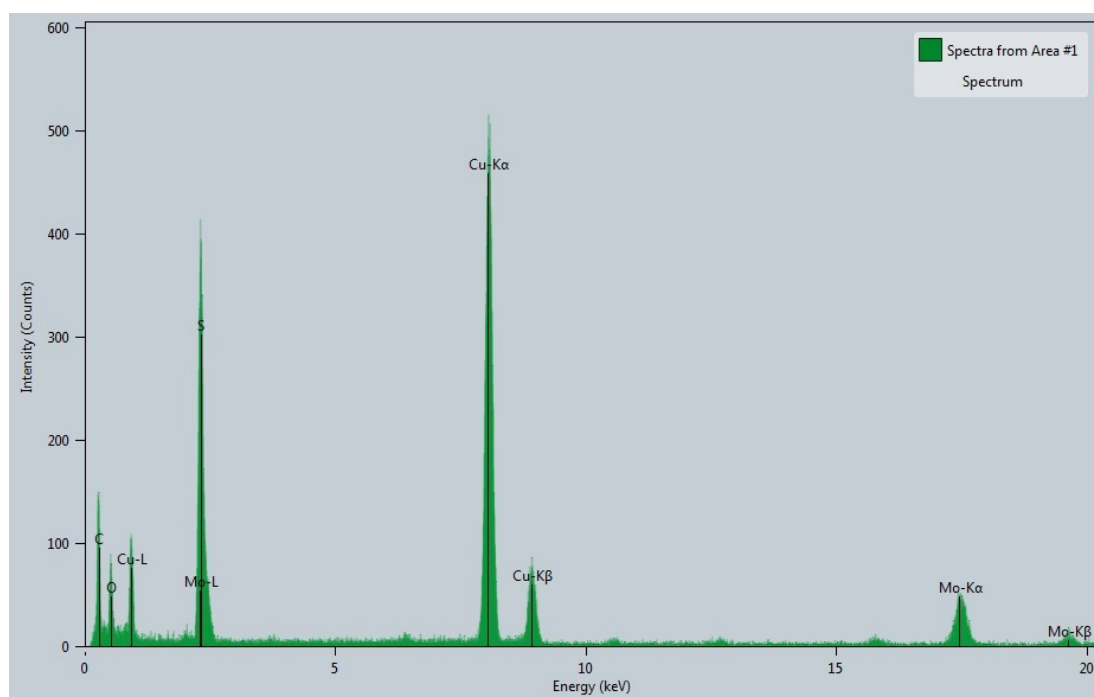


Fig. S2 EDS mapping of elemental content of MoS₂ nanosheets.

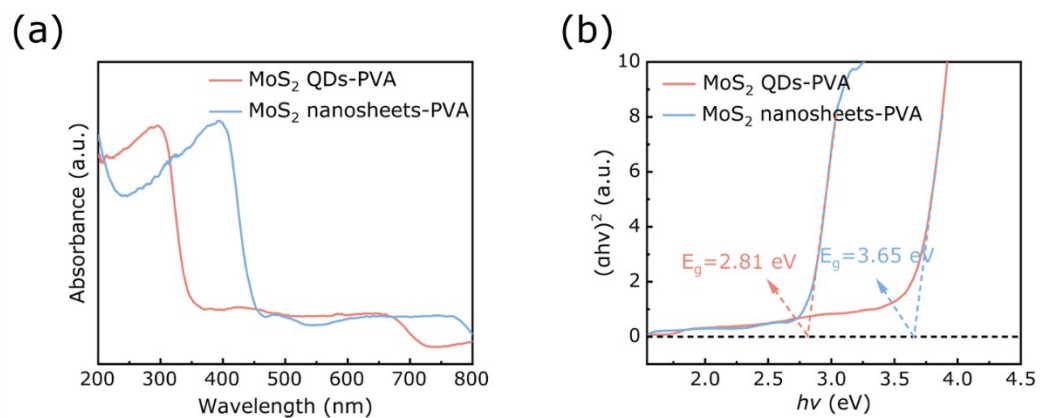


Fig. S3 (a) The UV-vis spectra and (b) corresponding Tauc plots of MoS₂ nanosheets-PVA films and MoS₂ QDs-PVA films.

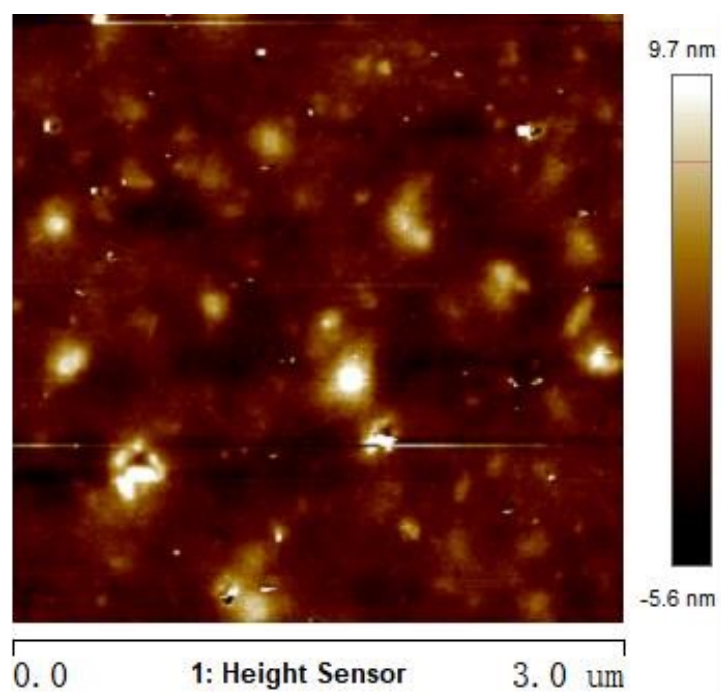


Fig. S4 AFM map of MoS₂ QDs-PVA hybrid thin film surface.

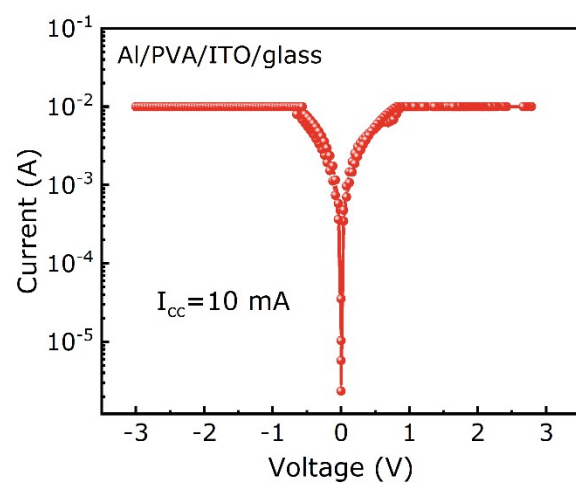


Fig. S5 The I-V diagram of Al/PVA/ITO/glass device.

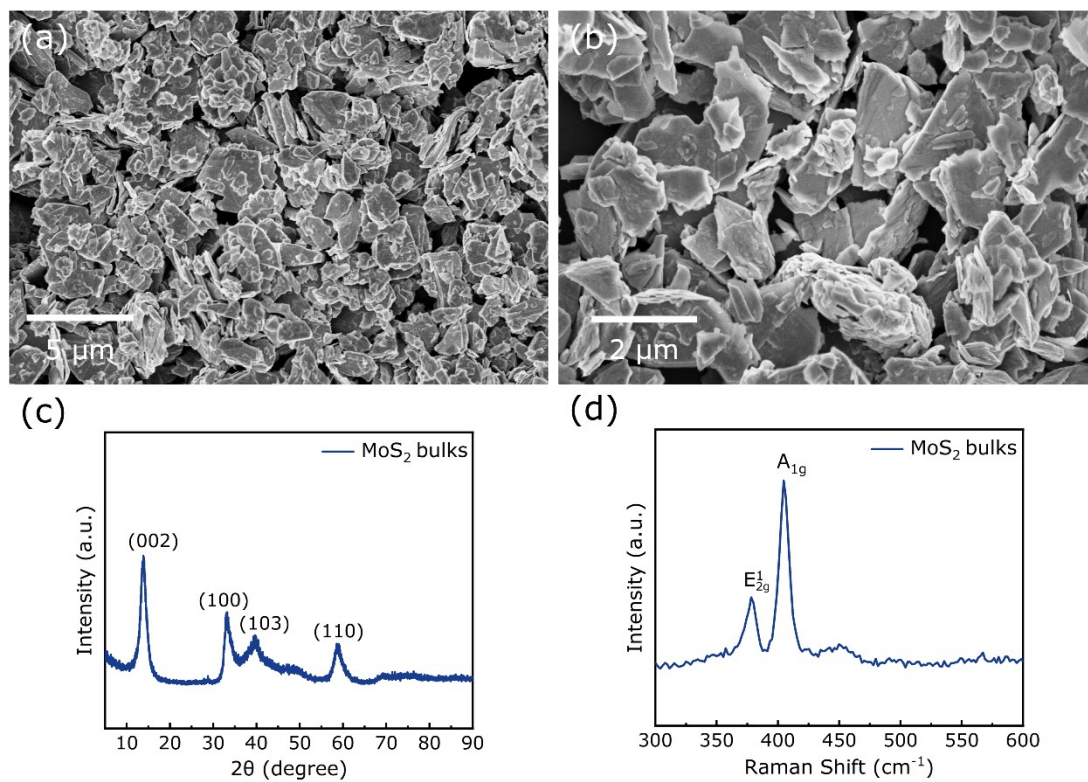


Fig. S6. (a-b) SEM image, (c) XRD pattern and (d) Raman pattern of MoS₂ bulks.

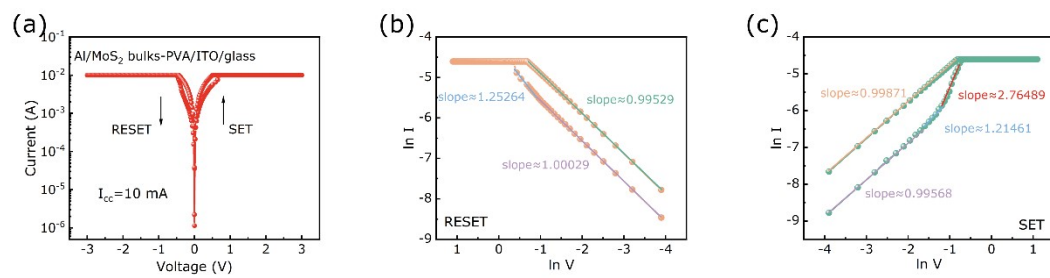


Fig. S7 (a) The I-V curves and (b-c) double logarithmic curves of Al/MoS₂ bulks-PVA/ITO/glass devices.

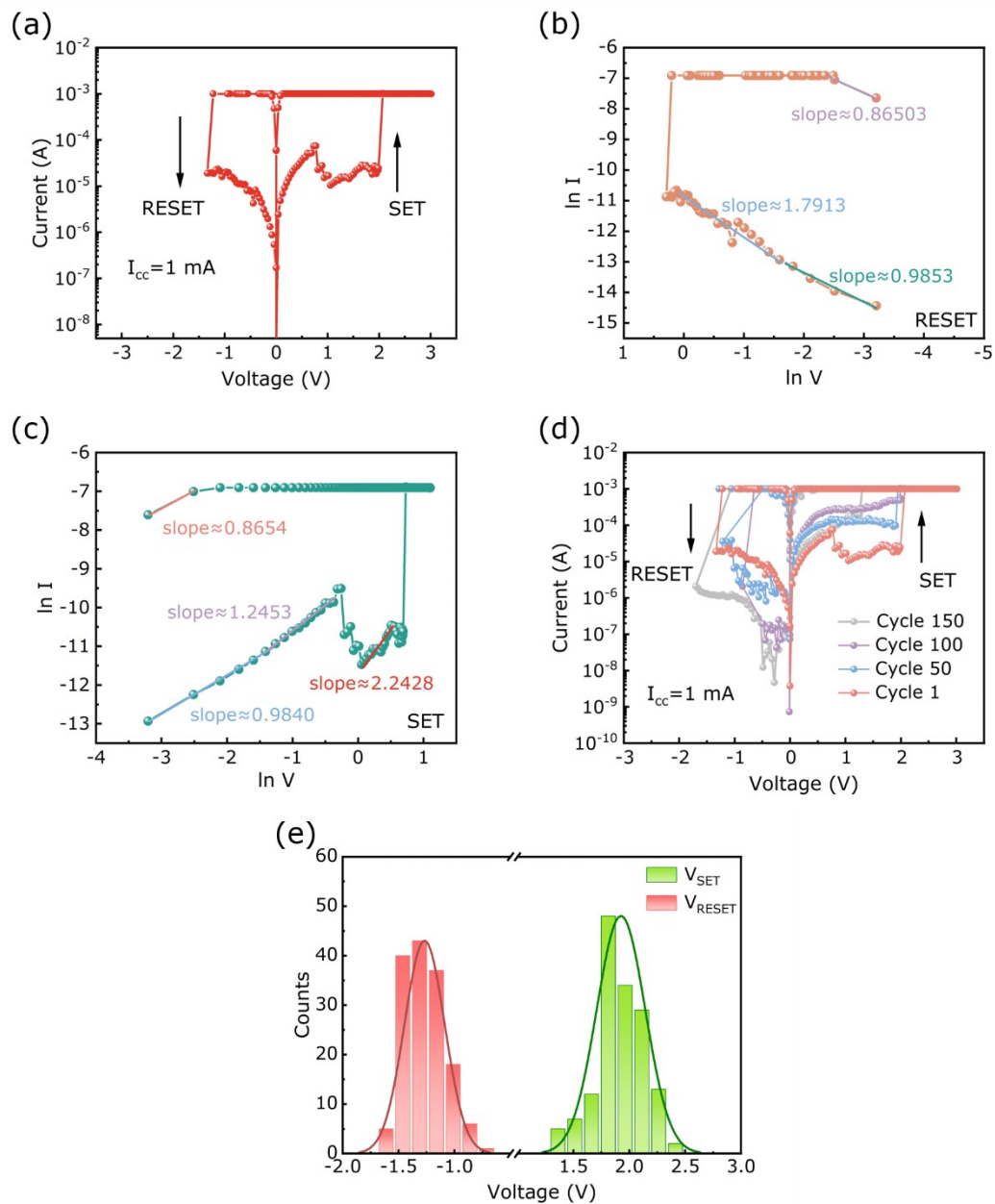


Fig. S8 (a) The I-V curves, (b-c) double logarithmic curves during SET and RESET processes, (d) I-V curves for 150 cycles, and (e) histograms of the distribution of V_{SET} and V_{RESET} for the Al/MoS₂ QDs-PVA/ITO/glass device at a compliance current of 1 mA.

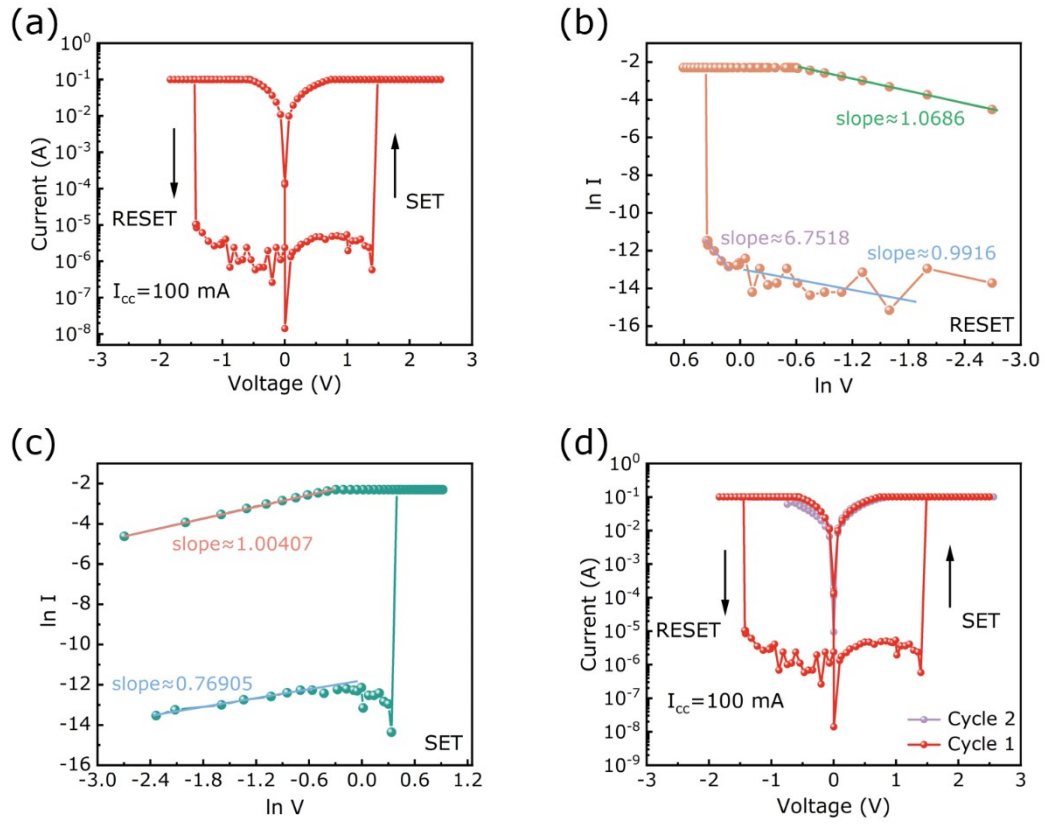


Fig. S9 (a) The I-V curves, (b-c) double logarithmic curves during SET and RESET processes, and (d) I-V curves for 2 cycles for the Al/MoS₂ QDs-PVA/ITO/glass device at a compliance current of 100 mA.

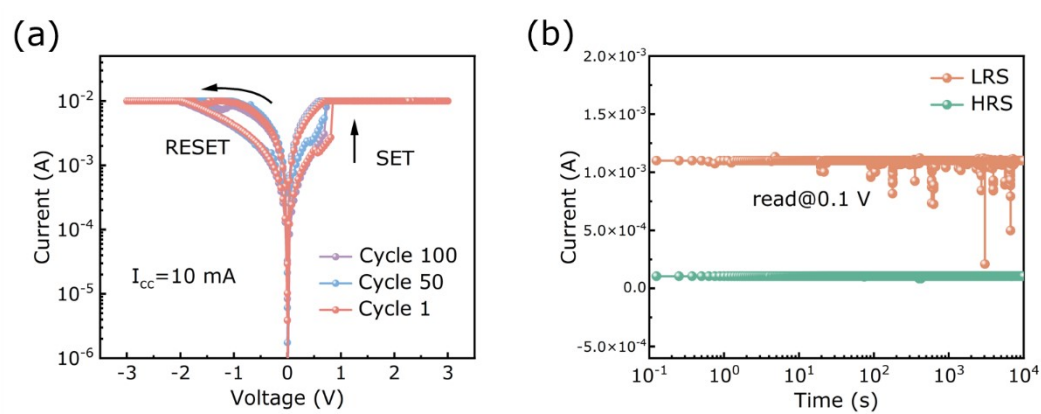


Fig. S10 (a) I-V curves for 100 cycles and (b) I-t plot for Al/MoS₂ nanosheets-PVA/ITO/glass device.

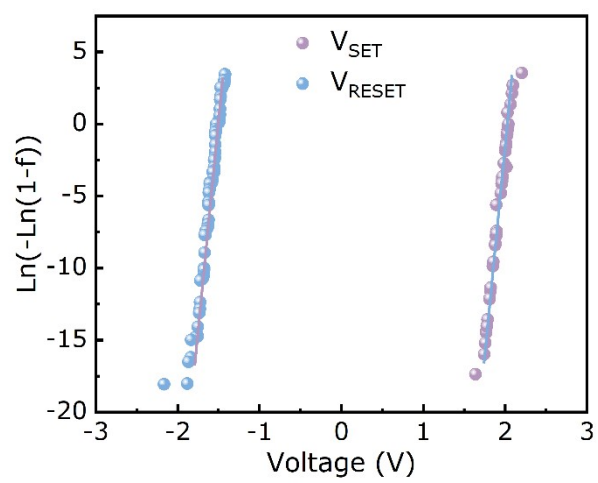


Fig. S11 Weibull distribution of V_{SET} and V_{RESET} for Al/MoS₂ QDs-PVA/ITO/glass device.

Table S1 Statistical measures and Weibull distribution parameters of Al/MoS₂ QDs-PVA/ITO/glass devices.

Parameters	Mean (V)	Standard. deviation (V)	Coefficient of variation	β	$x_{63\%}$
V_{SET}	1.98097	0.16951	0.08557	101.6030	2.04
V_{RESET}	-1.56886	0.14833	0.09455	81.4538	1.619

The Weibull cumulative distribution function for V_{SET} and V_{RESET} is defined as^{11,12}:

$$f = 1 - \exp\left[-\left(\frac{|V|}{\alpha}\right)^\beta\right]$$

where α is the scale parameter of the Weibull distribution at 63.2% and β is the shape/slope parameter, which measures the spread of the distribution.

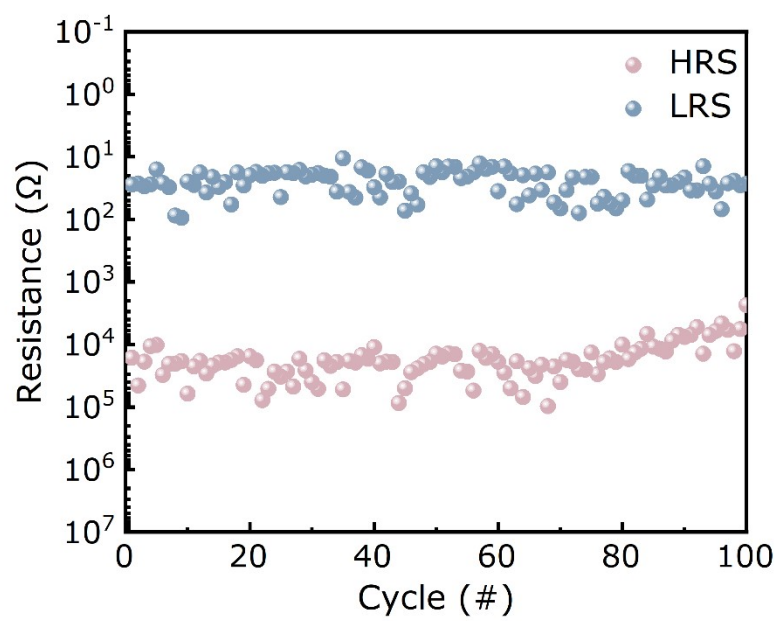


Fig. S12 Resistance variation of Al/MoS₂ QDs-PVA/ITO/glass device for 100 cycles.

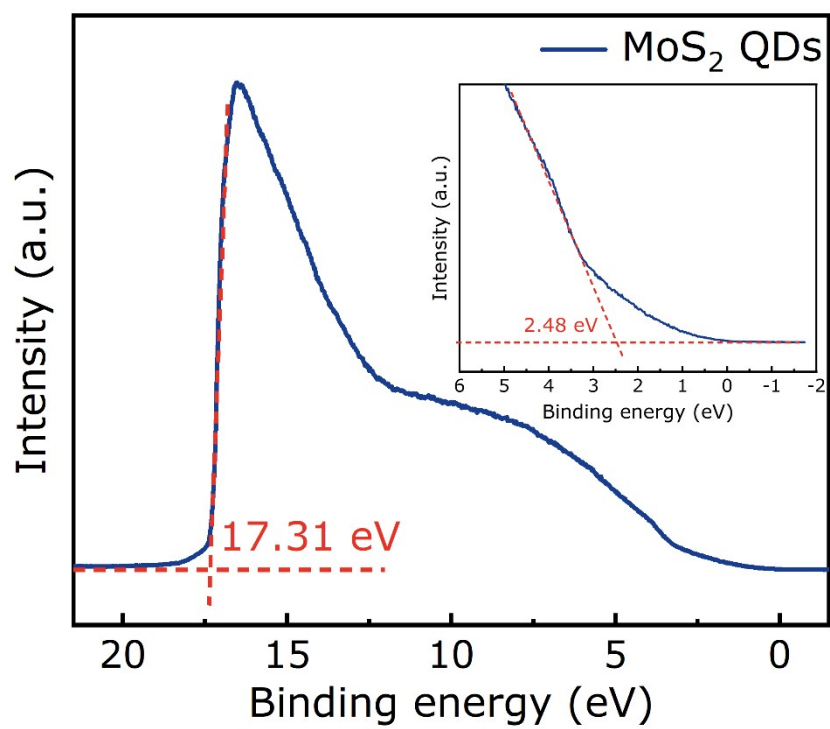


Fig. S13 Ultraviolet photoelectron spectra (UPS) of MoS₂ QDs.

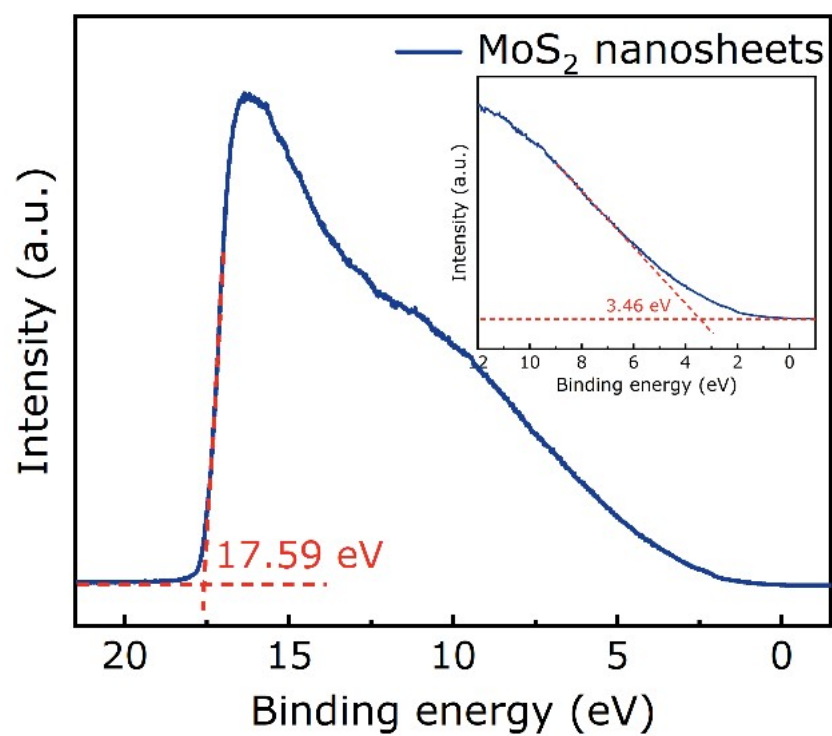


Fig. S14 Ultraviolet photoelectron spectra (UPS) of MoS₂ nanosheets.

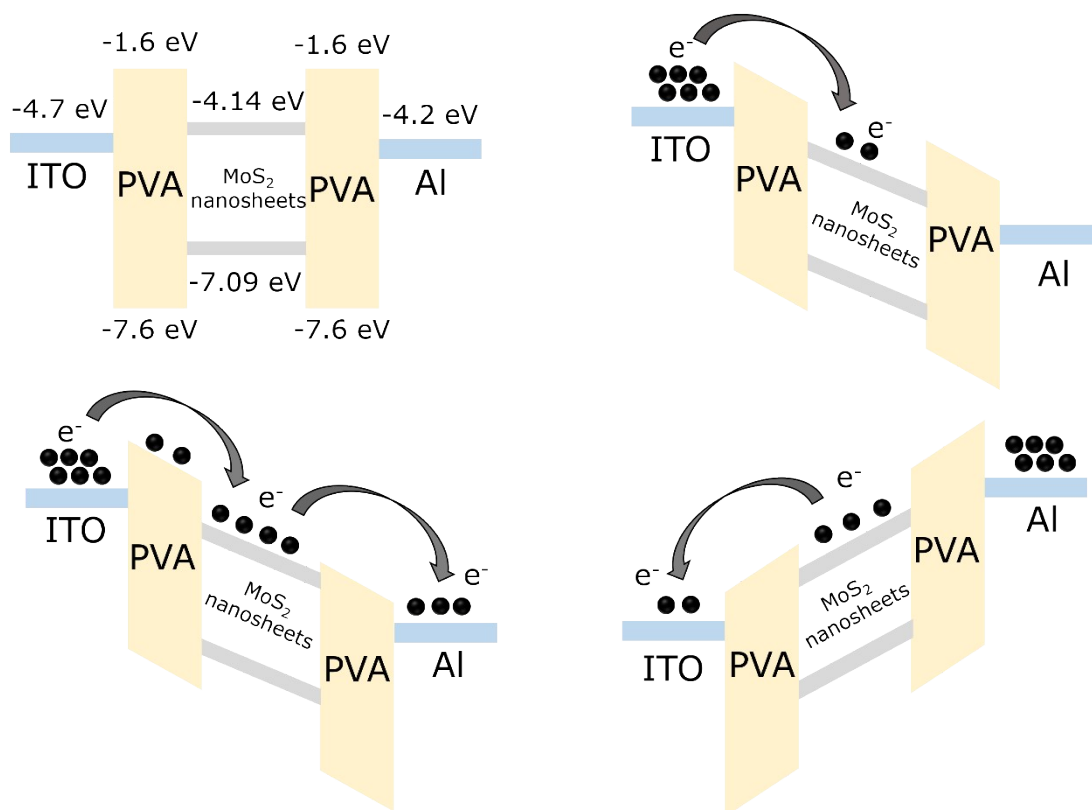


Fig. S15 Schematic diagram of the RS mechanism of Al/MoS₂ nanosheets-PVA/ITO/glass device.

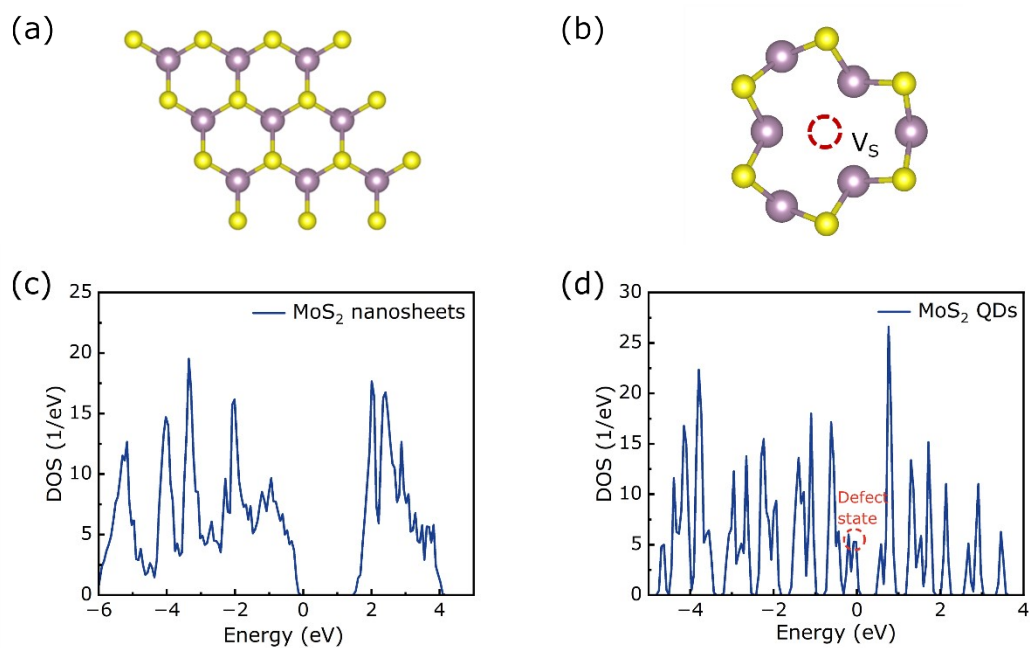


Fig. S16 Schematic diagram of crystal structure of (a) MoS₂ nanosheets and (b) MoS₂ QDs. The DOS plots of (c) MoS₂ nanosheets and (d) MoS₂ QDs.

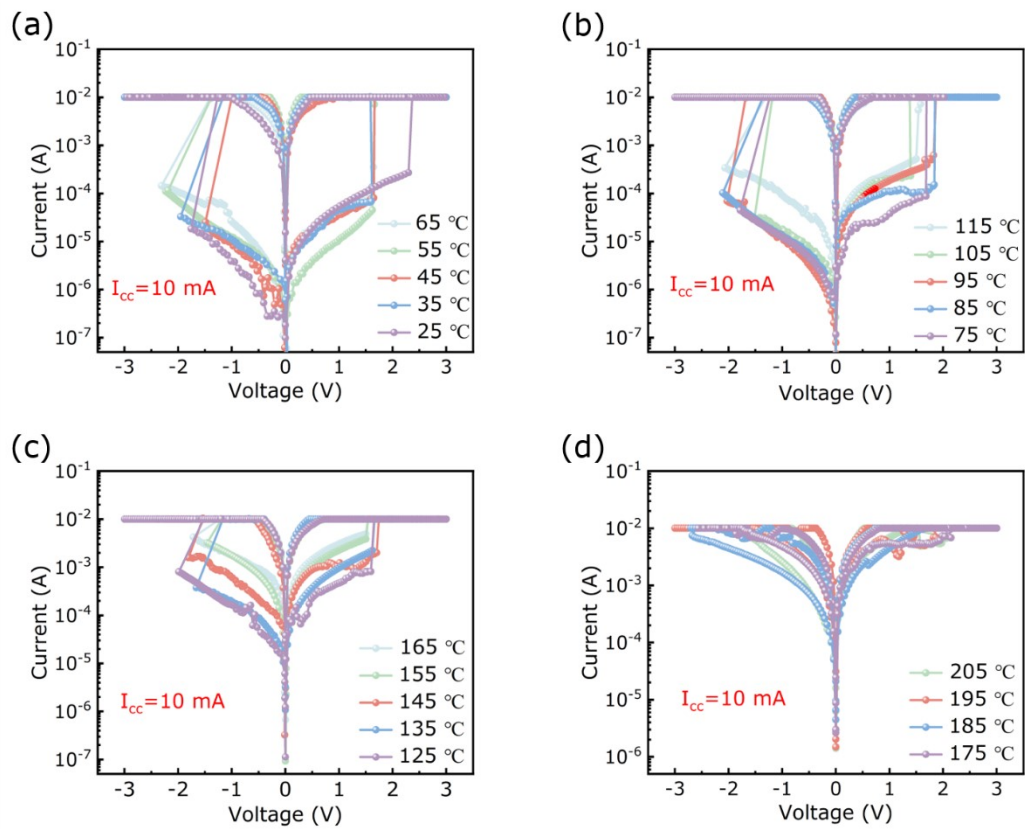


Fig. S17 2D plots of resistive switching corresponding to different temperatures for Al/MoS₂ QDs-PVA/ITO/glass device.

Table S2 Comparison of the key performance parameters of MoS₂-based RRAM device.

Structures	$V_{\text{reset}}/V_{\text{set}}$ (V)	Endurance cycles	Retention time (s)	Reference
Al/MoS ₂ QDs-PVA/ITO/glass	-1.78/2.21	100	10 ⁴	This work
Al/MoS ₂ QDs/FTO	-1.35/2.2	30	10 ³	[3]
Au/MoS ₂ /Au	-0.9/2.7	20	10 ⁴	[4]
Ag/Ta ₂ O ₅ /MoS ₂ QDs/Pt	-0.1/0.2	200	10 ⁴	[5]
Au/MoS ₂ QDs/Au	-0.85/1.2	60	10 ³	[6]
ITO/(MoS ₂ :PS)/Al	-2.5/2.7	25	400	[7]
Al/CPB QDs/MoS ₂ /FTO/glass	-0.55/0.75	100	10 ⁴	[8]
Ag/MoS ₂ /Au/Ti/PET	-0.8/1.1	90	10 ⁴	[9]
ITO/QDs/MoS ₂ /TiO ₂ /Pt	-0.95/2.23	100	10 ⁴	[10]
Ag/ZnO/MoS ₂ QDs/W	-1.52/1.23	200	10 ⁴	[11]
Al/MoS ₂ -PDA-PFMMA/ITO	-0.9/1.1	60	10 ⁴	[12]

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