# Electronic Supporting Information

## Resistive switching behaviors and memory logic functions in single $MnO_x$ nanorod modulated by moisture†

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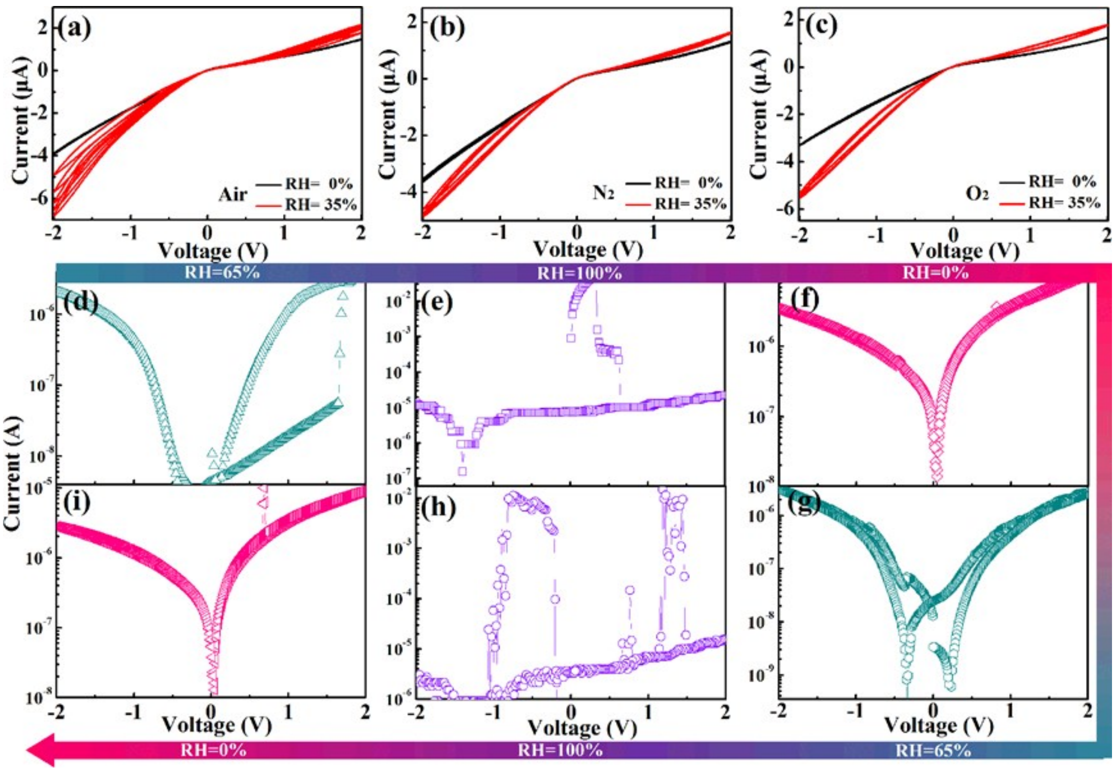


**Fig. S1** Moisture-dependency of RS behaviors in (a) air amiben, (b) $N_2$ and (c) $O_2$ atmosphere. The RS behavior under different RH levels: (d), (g) The humidified synthetic air with RH of 65%; (e), (h) The humidified synthetic air with the RH level of 100% and (f), (i) the dry air with the RH level of 0%. One can see that the reversion between resistor and memristor is reversible, despite the RS behaviors are not so stable.

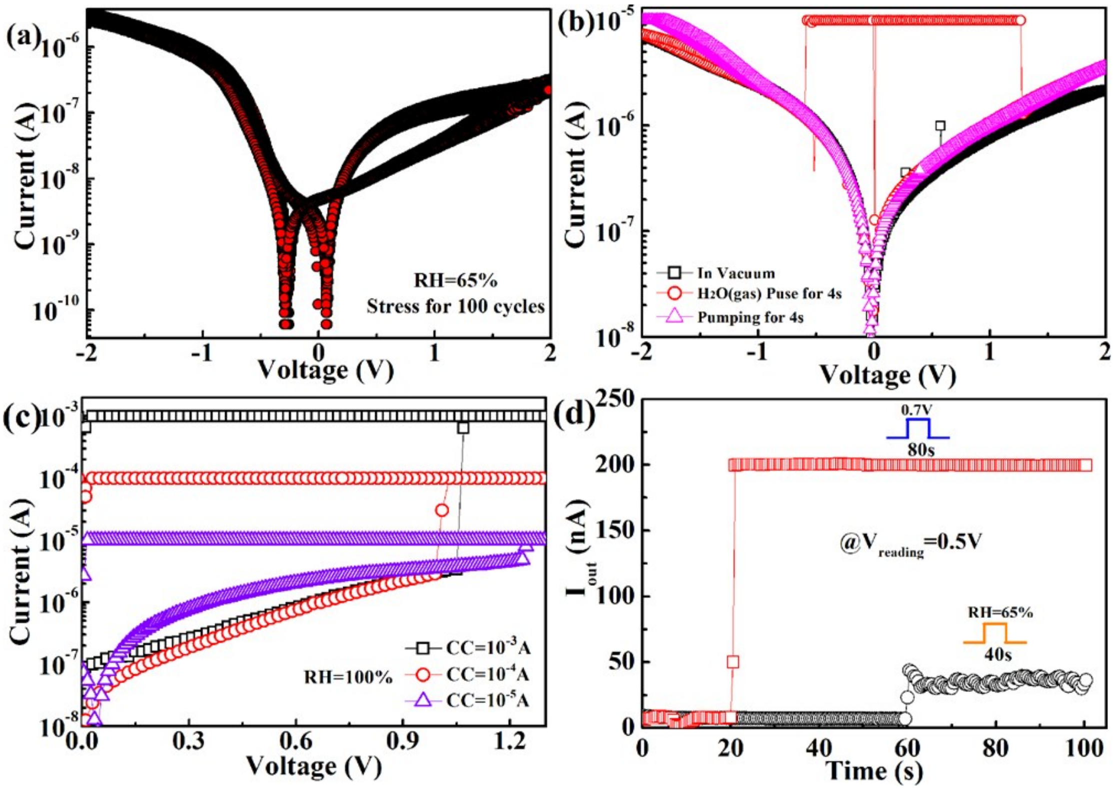


**Fig. S2** (a) Cycling endurance of RS behavior for the device in RH of 65%. (b) Reversing between resistor and memristor under vacuum and moisture ambient. (c) Compliance current dependency of the RS behavior under RH of 100%. (d) Current *versus* time relations for the input pulse of 0.7 V for 80s and the RH of 65% for 40s.

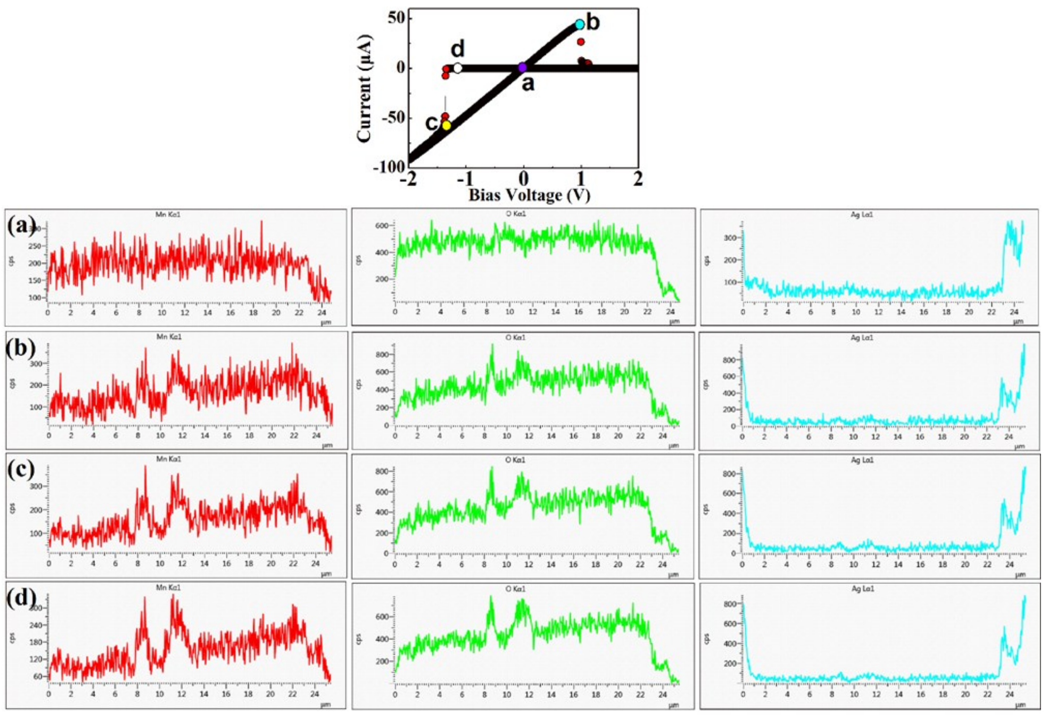


**Fig. S3** EDX spectra of the nanomicro wire of $MnO_x$-based lateral device under different RS states: (a) Initial HRS state; (b) SET; (c) RESET and (d) Switching back to HRS.

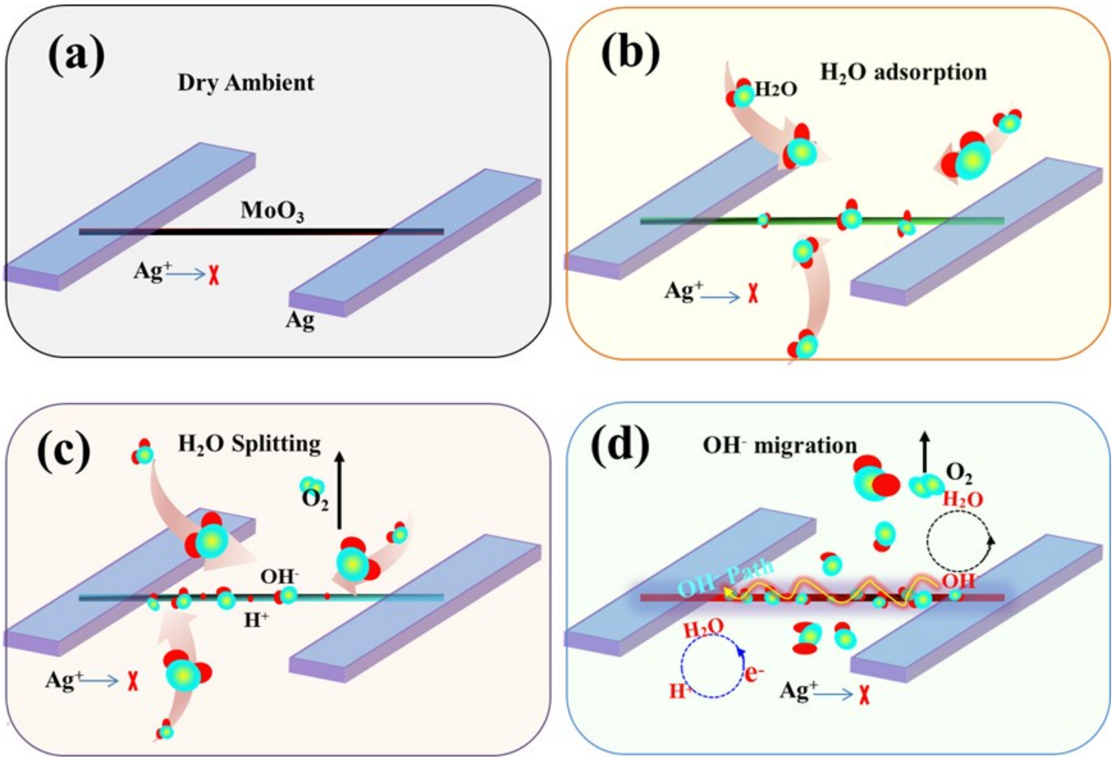


**Fig. S4** Physical mechanism is proposed to comprehend the reversion between resistor and memristor. (a) The device presents in dry ambient. (b) $H_2O$ molecule adsorption on the surface of the $MnO_x$ nanorod. (c) $H_2O$ molecule splitting process due to the $H_2O$ redox reaction with surface oxygen vacancy. (d) Massive $OH^-$ ion suspends on the surface of the $MnO_x$ nanorod and then migrates along the surface to form conduction paths.

**Experimental Details**

*$MnO_x$ nano-micro rod synthesis.* Hydrothermal method is employed to synthesis the $MnO_x$ nanorod. 0.5 g $Mn(NO_3)_2 \cdot 4H_2O$ and 0.05 g NaOH are dissolved into 25 mL deionized water and continuously stirs for 24 hours at room temperature to form precursor solution. The precursor solution is transferred into teflon-lined steel autoclave, which is heated at 200℃ for 18 hours. After that, the $MnO_x$ nanorod and fragments are formed in the post hydrothermal reaction solutions. The $MnO_x$ nanorod can be finally obtained after centrifugal separated using deionized water for 4 times.

*Lateral device fabrication.* The 0.003g $MnO_x$ nanorod is diluted into 50 mL deionized water. The dilute solution of 1.0 μL is spin coated on the surface of Si|$SiO_2$ substrate at 6000 rpm for 60 seconds. Then, the single $MnO_x$ nanorod is mechanically selected using the Pt probe. After that, electragol is dropped into the both ends of single $MnO_x$ nanorod.

*Moisture levels controlling.* Air ambient of laboratory of relative humidity(RH) is 35%±3%. The RH of 0% can be obtained by pumping the probe station to $5\times10^{-4}$ Pa and then injecting the dry air (20% $O_2$, 80% $N_2$, $H_2O$<5 ppm), which is viable by flowing air through three interconnected heated-glass delivery tubes filled with dry calcium oxide powers. The moist ambient with RH of 65%±5% or and 95% ± 5% is achieved by passing the laboratorial air through a gas-washing bottle filled with deionized water. A min-hygrometer is employed to detect the humidity levels.

*Structural characterization and I-V measurement*. Surface morphology and chemical component are characterized field emission scanning electron microscope(FE-SEM, JSM-6510) and X-ray photoelectron spectroscopy(XPS, 250Xi), respectively. Test system consisted by the electrochemical analyzer (CHI, 660D) and Lake Shore probe station(TTPX) are employed to conduct the I-V measurement.