Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Supporting Information

Electric field control of resistive switching and magnetization in epitaxial $LaBaCo_2O_{5+\delta}$ thin films

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1. C-V characteristic of the device

To explore the conduction mechanism, capacitance-voltage *(C-V)* characteristics of the device in the LRS and HRS states were measured at a frequency of 1 MHz. As shown in Figure S1, the capacitance of the LRS state is comparable to that of the HRS, which further rules out the metallic conductive filament mechanism.

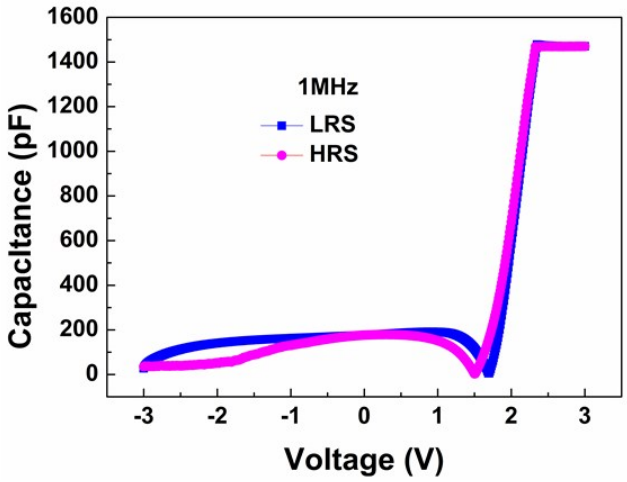

Figure S1. Capacitance-voltage *(C-V)* loops measured at 1 MHz in the voltage scanning range of -3 to +3 V.

2. Effect of ambient atmospheres on the resistive switching

To future confirm the mechanism, we did measurements in oxygen, vacuum and N_2 to see whether vacuum and N_2 would affect the switching performance. Figure S2 shows the *I-V* curve of the device in oxygen, vacuum and N_2 ambient; the device exhibits poor stability with non-hysteresis loops when placed in both vacuum and N_2 ambient. Therefore, any scenario based on the migration and accumulation/depletion of holes/electrons at the interface can hardly explain the observed resistive switching behavior in the present device.

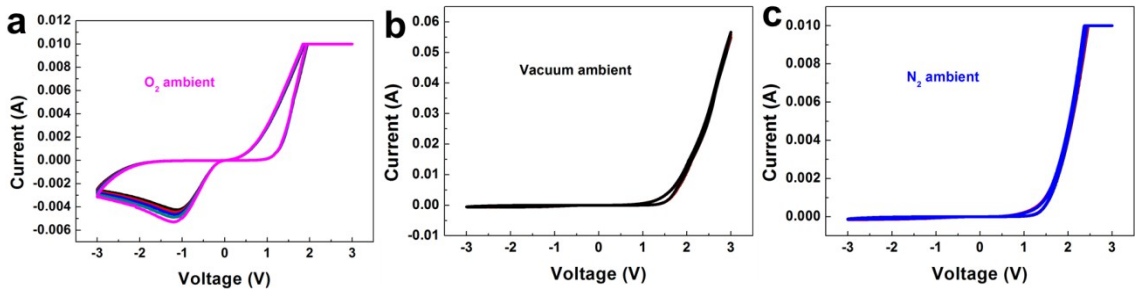

Figure S2. *I-V* curve of the device measured in a) oxygen b) N_2 and b) vacuum.

3. Switching speed

Figure S3 demonstrates the switching speed of our device. By applying pulses with different widths, the device shows a response speed of ~10 μs.

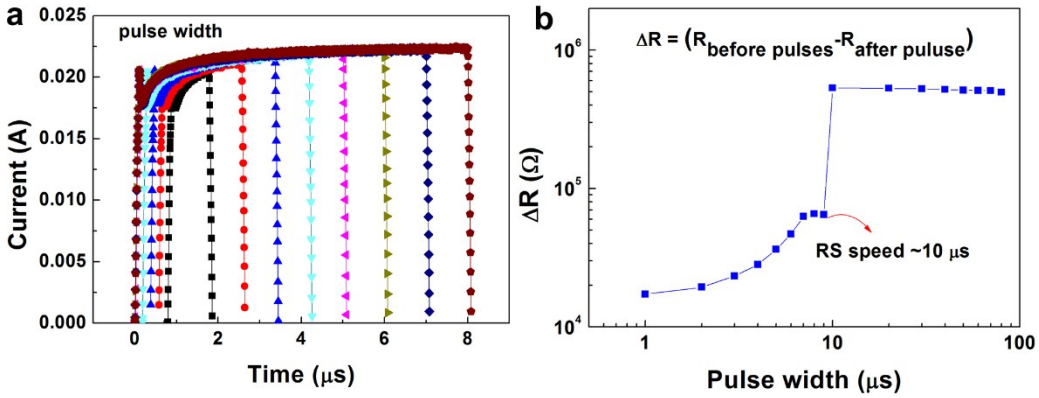

Figure S3. Experimental results demonstrate the response speed of the resistive switching. a) The response of current to pulses with various widths, and b) resistance as a function of pulse width.

4. Effect of oxygen vacancies on the magnetization

Figure S4 shows the magnetization of the as-grown LBCO film and the LBCO film annealed in oxygen. The magnetization of the annealed sample is obviously higher than

that of the as-grown LBCO film. Therefore, the concentration of oxygen vacancies in the as-grown LBCO has a close relationship with its corresponding magnetization.

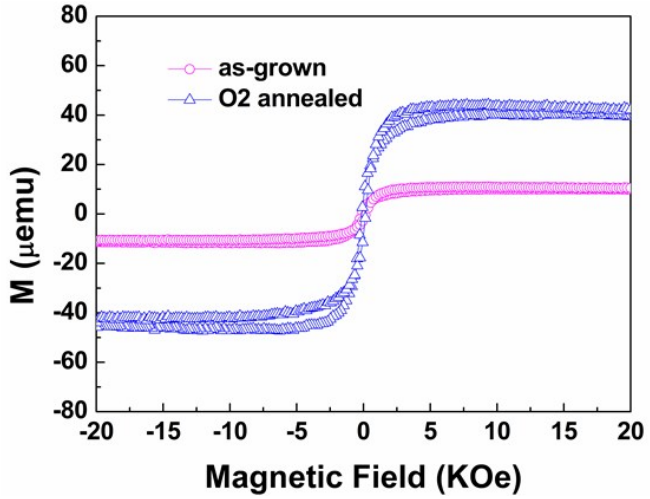

Figure S4. Magnetization of the as-grown LBCO film and the LBCO film annealed in oxygen, indicating that the magnetization of the film increases with oxygen incorporation.