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

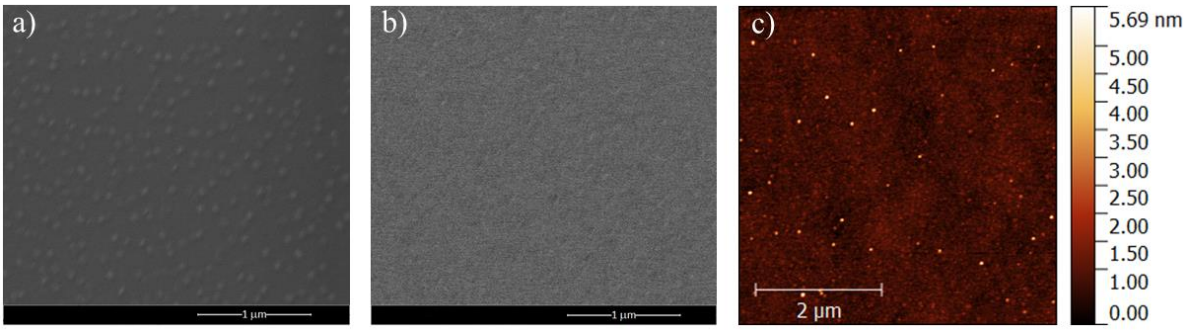

Figure S1. The typical surface of the GBCO/LNO//STO heterostructure for a GBCO layer of approx. 20 nm thickness. a) Secondary electron SEM image showing a smooth surface on the large scale and b) a homogenous chemical composition in the backscattered electron contrast image. c) AFM image of a similar area, 0.123 nm average and 0.164 nm RMS roughness.

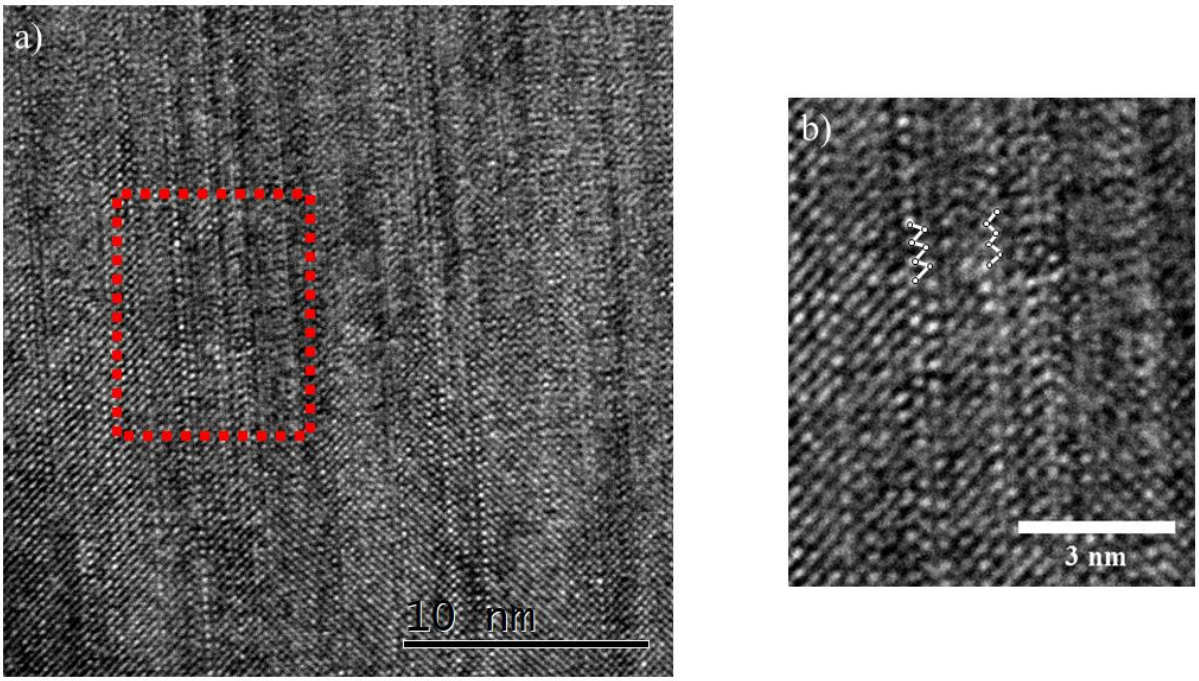

Figure S2. HRTEM image of the LNO layer displaying faults a) with a zigzag arrangement of the A-cations and a NiO_2 plane missing at the defect boundary b) enlarged region of figure a).

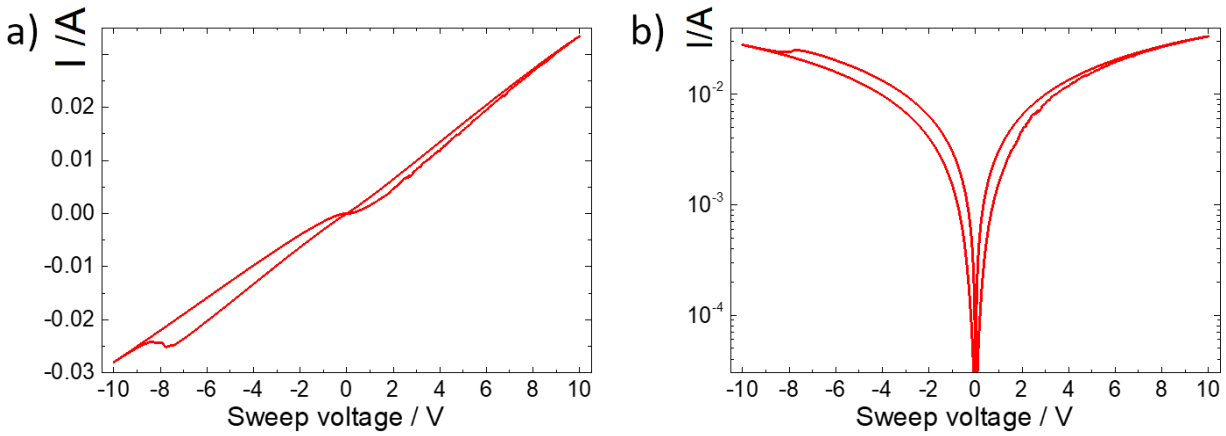

Figure S3. I(V) curve in a) linear and b) logarithmic scale during one switching cycle (0 V to -12 V, -12 V to 0V, 0 to +12 V and +12 V to 0 V sweeps) measured on a $GdBaCo_2O_{5+\delta}$/ $LaNiO_3$// $SrTiO_3$ device.

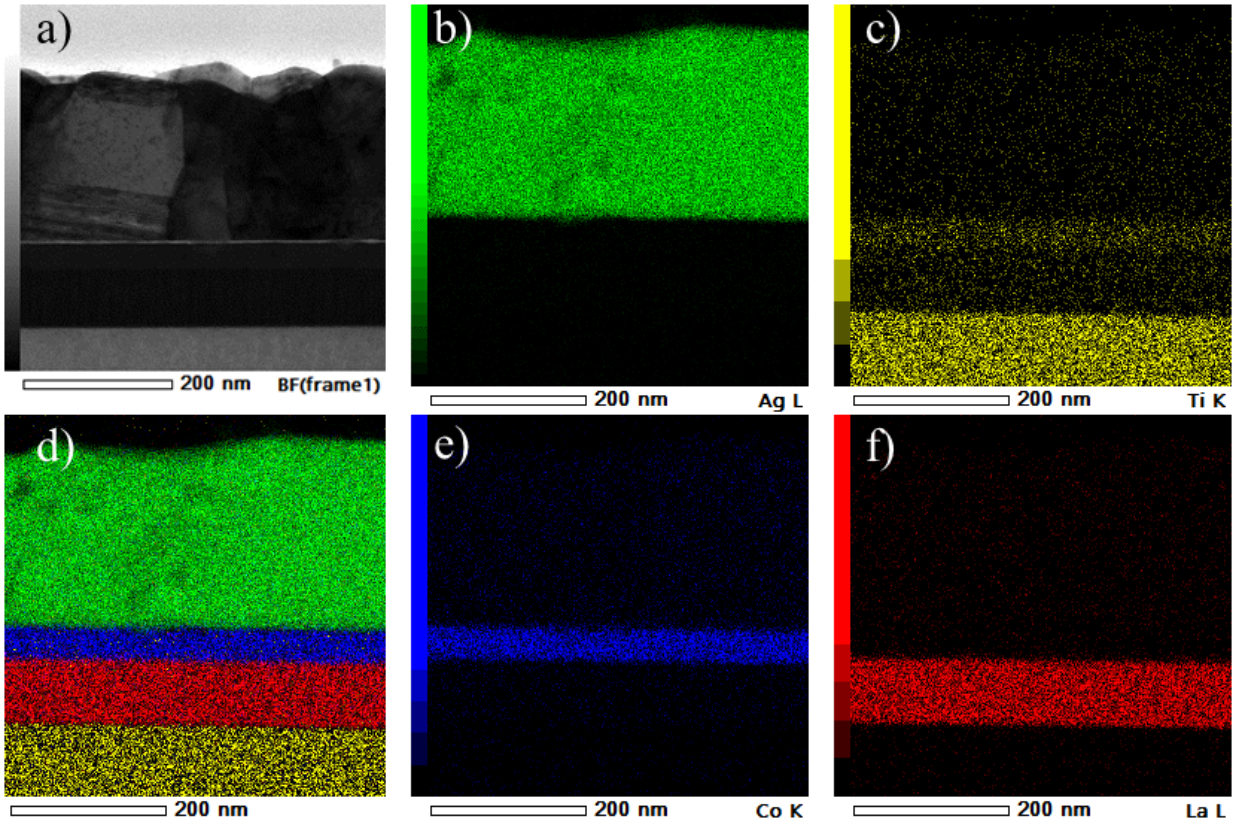

Figure S4. STEM investigation of the Ag/GBCO/LNO//STO heterostructure (after electrical characterization and RS). STEM BF cross section image in a) with the combined STEM EDX image in d) (color code is the same as in the other EDX images). The Ag/GBCO interface is flat, continuous and sharp. No Ag migration was observed in the GBCO heterostructure which was used for electrical resistive switching experiments. Separate EDX observations for Ag L line in b), Ti K line in c), Co K line in e) and La L line in f). $GdBaCo_2O_{5+\delta}$ = GBCO, $LaNiO_3$ = LNO and $SrTiO_3$ = STO.

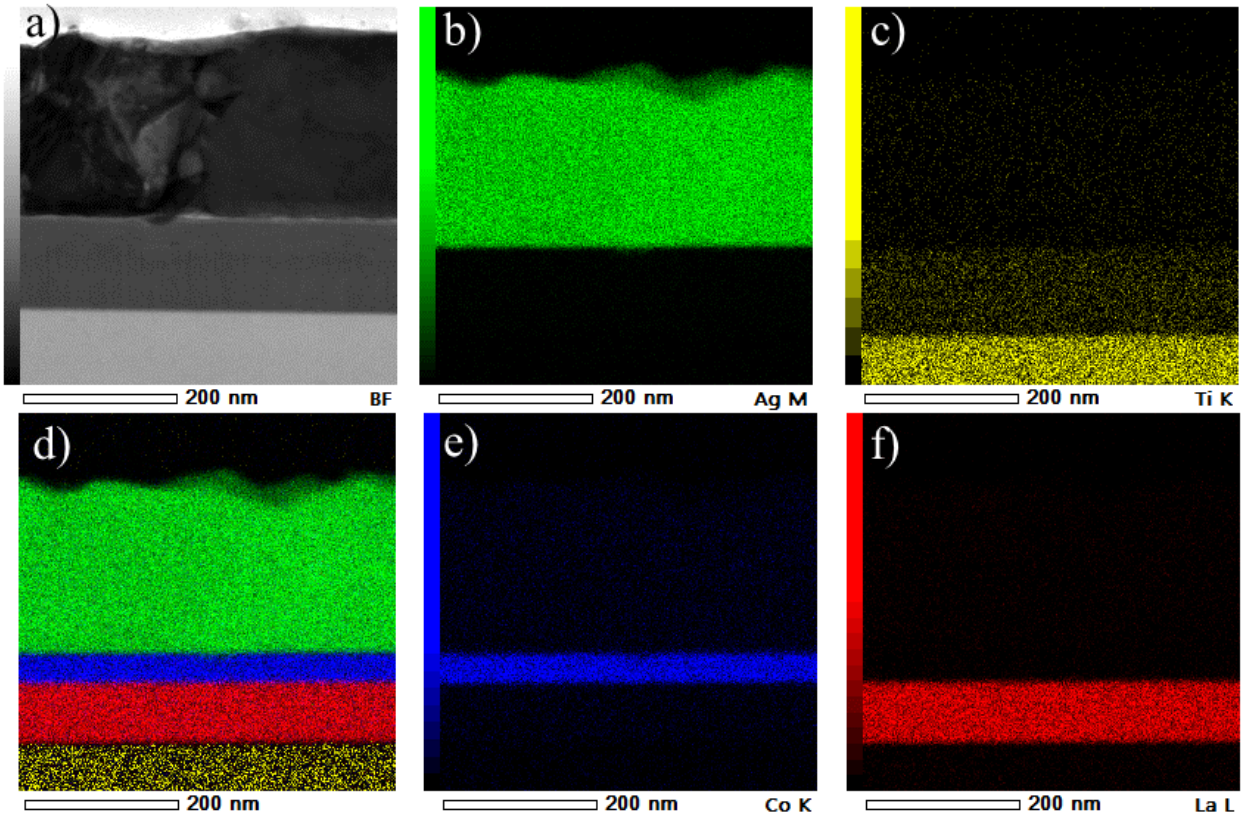

Figure S5. STEM investigation of the Ag/GBCO/LNO//STO heterostructure (virgin, no electrical stimulus was ever applied). STEM BF cross section image in a) with the combined STEM EDX image in d) (color code is the same as in the other EDX images). The Ag/GBCO interface is flat, continuous and sharp. No Ag migration was observed in the GBCO heterostructure after the top Ag electrode deposition. Separate EDX observations for Ag M line in b), Ti K line in c), Co K line in e) and La L line in f). $GdBaCo_2O_{5+\delta}$ = GBCO, $LaNiO_3$ = LNO and $SrTiO_3$ = STO.

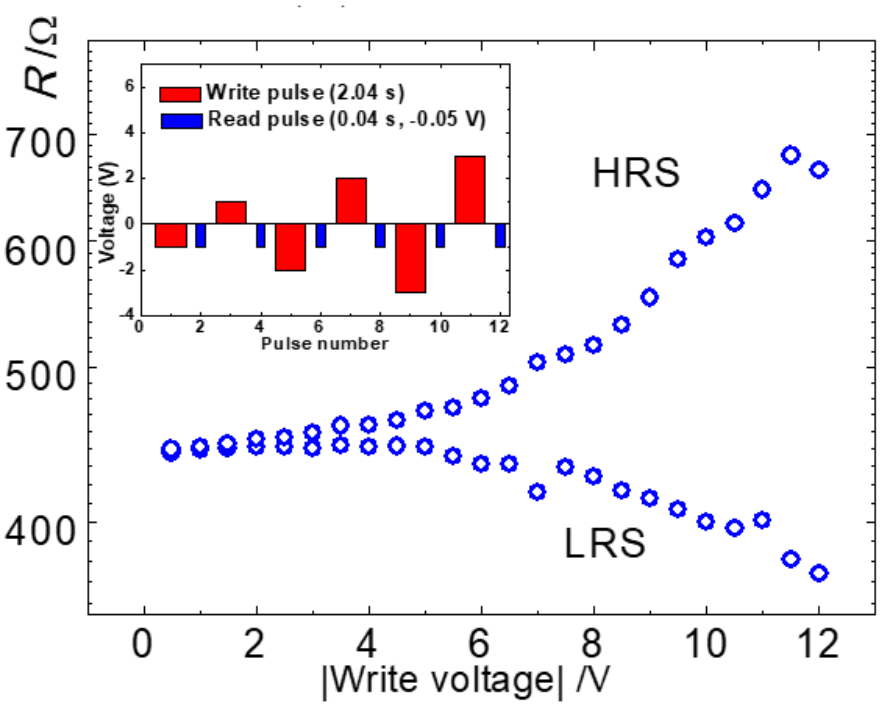

Figure S6. Multiple resistance state values of the memristive device measured in pulse mode by increasing the amplitude of the voltage pulses in steps of 0.5 V. Both the LRS and HRS values can be by adjusted changing the pulse voltage amplitude (inset shows the pulse scheme).