Supplemental Information

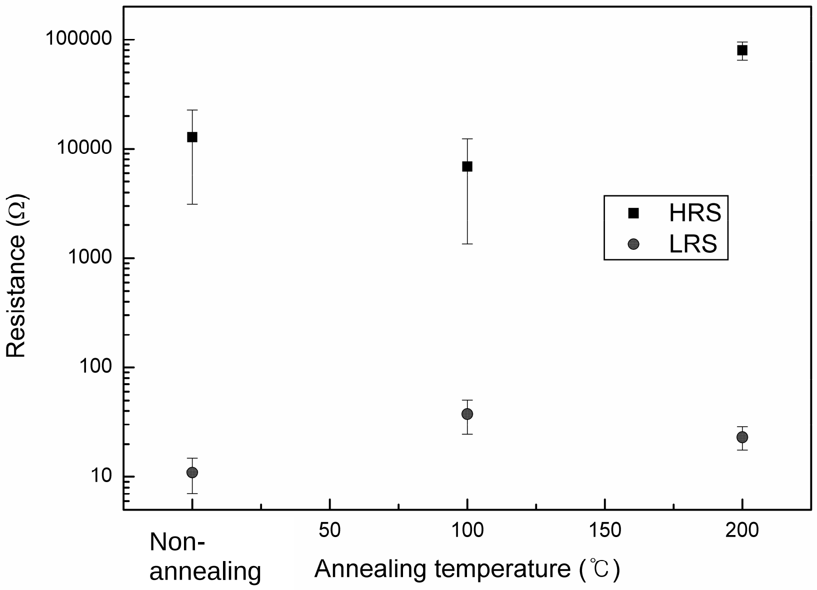

Figure S1. Switched states of our RRAM devices annealed at selected annealing temperatures. The switching characteristics of RRAM devices annealed at 200 ^oC are superior to those of non-annealed RRAM devices or to RRAM devices annealed at 100 ^oC in terms of the on/off ratios and variations of resistance states. Each of the data points corresponds to the average value of resistance obtained from ten RRAM devices prepared under the same annealing condition. The variance in the resistance values obtained from the non-annealed RRAM devices is more significant than the RRAM devices annealed at 200 ^oC.

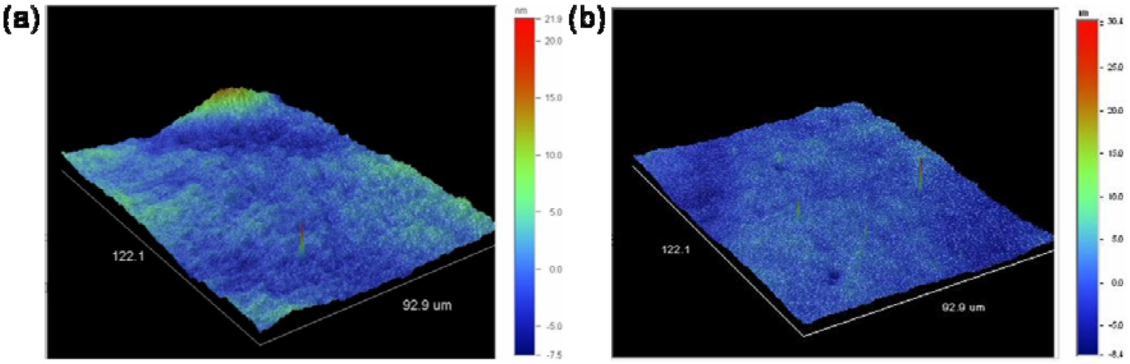

Figure S2. Optical profiler images of the TiO_2 film of the RRAM device before annealing (a) and after annealing at 200 ^{o}C (b). The RMS roughness of the surface of the TiO_2 film was reduced from 2.31 to 1.90 by the annealing process.

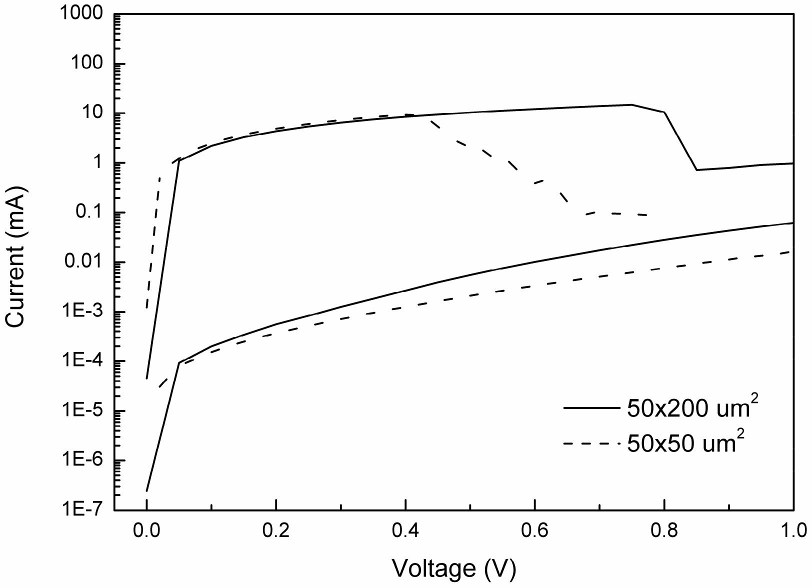

Figure S3. I-V curves obtained from two different RRAM devices with their surface sizes of 50x50 μm^2 and 50x200 μm^2. A comparison of the I-V curves indicates that the resistive characteristics of our RRAM device are independent of the surface size of the titanium oxide film contacted with the electrodes.

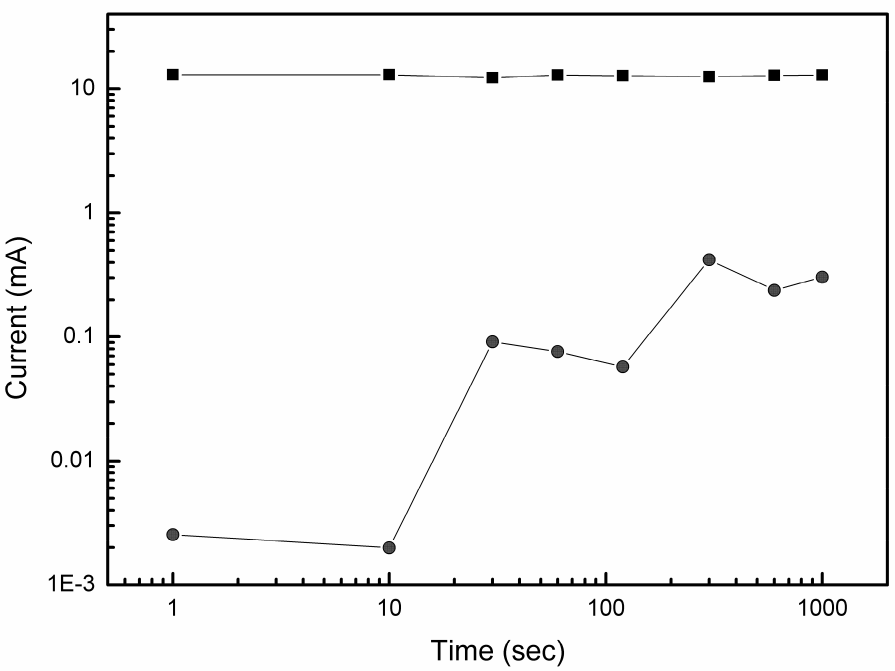

Figure S4. The retention properties of our RRAM device measured at 80 °C. The HRS is more sensitive to temperature than the LRS. The temperature dependence of the resistance switching transport agrees well with the results previously obtained for polycrystalline NiO films[a)]. In the HRS, weak metallic conduction and correlated barrier polaron hopping are involved in the resistance switching transport, which has an influence on the defect configuration.

a) K. Jung, H. Seo, Yo. Kim, H. Im, J. Hong, J.W. Park and J.K. Lee, *Appl. Phys. Lett.*, 2007, **90**, 052104.