Optically induced sensing of memristors based in LSMO/BTO/ITO ferroionic tunnel junctions

Isabel Tenreiro,[1] Víctor Rouco,[1] Gabriel Sánchez-Santolino,[1] Fernando Gallego,[2] Carlos Leon,[1] **Alberto Rivera-Calzada**,[1*] Ivan K. Schuller,[3] and Jacobo Santamaria[1]

[1]Departamento de Física de Materiales, Universidad Complutense de Madrid, 28040 Madrid, Spain.
[2]Unité Mixte de Physique, CNRS, Thales, Université Paris Sud, Université Paris-Saclay, F-91767 Palaiseau, France
[3]Department of Physics, Center for Advanced Nanoscience, University of California, San Diego, 92093, USA.
Contact email: alberto.rivera@ucm.es

The low power sensing of the non-volatile resistive states of memristors is an important challenge for the implementation of energy efficient neuromorphic computing. Ferroionic tunnel junctions are known to have a resistive switching mechanism ruled by the reversible build up of a Schottky barrier, causing the voltage-driven modulation in the resistance of the different memristive states [1]. In this work we take advantage of the Schottky barrier to get an active reading of the memristive states in a $La_{0.7}Sr_{0.3}MnO_3/BaTiO_3$/ITO ferroionic tunnel junction with a 3 nm thick $BaTiO_3$ layer [2,3]. The Schottky barrier formed in the $BaTiO_3$ layer dramatically enhances its optical sensibility and produces a photovoltaic response when illuminated with a UV LED, which open circuit voltage V_{oc} correlates linearly with the resistance of each state, enabling the active sensing of the memristive state.

References

[1] R. Guo, W. Lin, X. Yan, T. Venkatesan, and J. Chen, Appl. Phys. Rev. **7**, 011304 (2020).
[2] A. Rivera-Calzada, F. Gallego, Y. Kalcheim, P. Salev, J. del Valle, I. Tenreiro, C. León, J. Santamaría, and I.K. Schuller, Adv. Electron. Mater. **7**, 2100069 (2021).
[3] I. Tenreiro, V. Rouco, G. Sánchez-Santolino, F. Gallego, C. Leon, A. Rivera-Calzada, I.K. Schuller, and J. Santamaria, Appl. Phys. Lett. **120**, 34101 (2022)

Figures

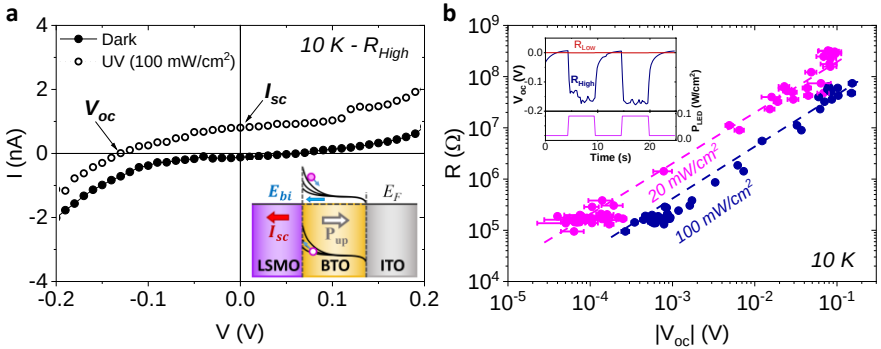

Figure 1: (a) I-V curves in the RHigh in dark and under UV illumination. Inset is a sketch of the band diagram, indicating the variation of the Schottky barrier for different memristive states. (b) Resistance of different memristive states at 10 K as a function of the measured $|V_{oc}|$. Dashed lines are guides for the eye with slope 1 corresponding to a linear correlation. The inset shows the time resolved V_{oc} for R_{High} and R_{Low} memristive states, measured under 5 seconds light pulses.