Nanometric Bias Induced Phase Transitions in materials.

Fábio G. N. Figueiras[1,2], Igor K. Bdikin[3], Vitor B. S. Amaral[1], Andrei L. Kholkin[3]

[1] Physics Dep. & CICECO, Aveiro University, 3810-193 Aveiro, Portugal.
[2] IFIMUP-IN, Sciences Faculty, Porto University, 4169-007 Porto, Portugal
[3] Mechanics Eng. Dep. & TEMA, Aveiro University, 3810-193 Aveiro,Portugal.
[4] Materials Eng. Ceramics Dep. & CICECO, Aveiro University,3810-193 Aveiro, Portugal
ffigueiras@ua.pt

Abstract

We present a research that opens a new pathway for the production of microelectronic chips like sensors, transducers and memory. This technology enables to imprint nano scale (re)programmable multifunctional electronic devices from a single material basis.

By means of Surface Probe Microscopy (SPM) methods, namely suitable bias lithography stimulation and piezo response mode, it is possible to induce localized electrochemical states and stabilize local nanometric CO/OO regions which exhibit clear electric/magnetic/structural functional responses in contrast with the original matrix material properties. The mechanism that underlie such versatile phenomena is based on a set of SCE materials (strong correlated electron systems) having specific compositions near the threshold of relevant phase transitions, that drastically alter some structural, electric or magnetic transport properties and while enabling the concomitance of the distinct phases in nonometric regions [1].

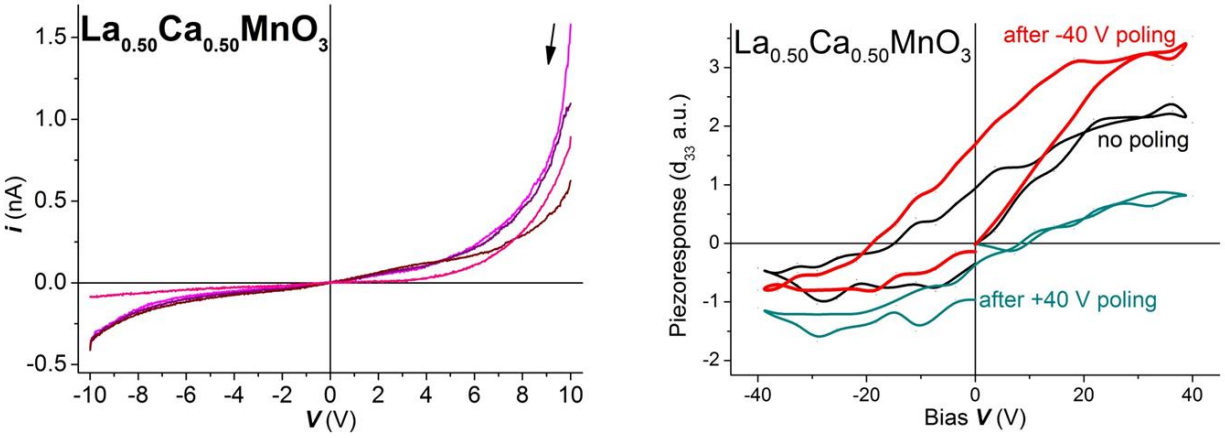

Figure: Consistent asymmetric effects of + or – bias poling are demonstrated in local SPM measurements of current versus voltage (left) and piezoresponse (right). Positive bias enhances electric conductivity while negative bias pooling sets a dielectric state and enables to observe piezoelectric loops.

References

[1] F. G. N. Figueiras, I. K. Bdikin, V. B. S. Amaral, A. L. Kholkin, “Local bias induced ferroelectricity in manganites with competing charge and orbital order states”, Phys.Chem.Chem.Phys., (2014), 16, 4977