Revisiting the ferroelectric field effect in a $SrRuO_3$ electrode

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The ferroelectric field effect can modulate the electrode resistance in capacitor geometry, depending on the ferroelectric polarization direction. Either charge accumulation or charge depletion is obtained, leading to an increase or a decrease of the electrode resistance, respectively. This effect is expected to be vanishingly small upon increasing the electrode thickness, being tied to the screening length at the ferroelectric/electrode interface. In this picture, we report on the resistance variation of a $SrRuO_3$ (SRO) film in the 1-10 nm thickness range, with either $BaTiO_3$ or $PbTiO_3$ as ferroelectric layer. All perovskite oxides were grown by pulsed laser deposition on $SrTiO_3$ substrates [1]. The devices were fabricated combining optical lithography, reactive ion etching of the oxide layers and lift-off process for the Pt top electrodes. The resistance variation of the SRO electrode was systematically measured upon switching the ferroelectric polarization, ranging from 0.4% (10 nm-thick SRO) to 25% (1 nm-thick SRO). The thickness and polarization dependences are discussed in terms of the charge screening and the ionic distortions at the ferroelectric/electrode interface.

[1] A. Aidoud *et al.*, Tuning the growth and strain relaxation of ferroelectric BaTiO3 thin films on SrRuO3 electrode: Influence on electrical properties, Eur. Phys. J. Appl. Phys. **80**, 30303 (2017)

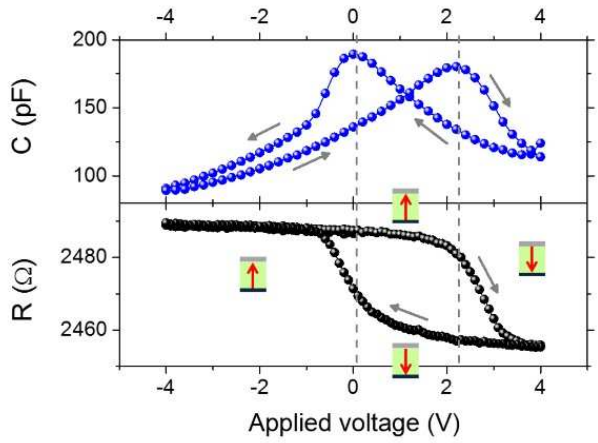

Figure 1 : Capacitance of a $BaTiO_3$ ferroelectric layer (top) and $SrRuO_3$ electrode resistance (bottom) as a function of applied bias on the capacitor. The hysteretic behavior (gray arrows) is tied to the reversal of the polarization in the ferroelectric layer (red arrows), as depicted in the figure.