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Electrical properties of epitaxial capacitors based on compressively strained $SrTiO_3$

Evgenios Stylianidis[1], Pavlo Zubko[1,2]

[1]*Department of Physics and Astronomy, University College London, Gower Street, London, WC1E 6BT UK*

[2]*London Centre for Nanotechnology, 17–19 Gordon Street, London, WC1H 0HA UK*

Since ferroelectricity was first predicted in strained $SrTiO_3$ in 2000 [1], numerous experimental studies have reported ferroelectric switching in tensile strained $SrTiO_3$ films [2]. For compressively strained $SrTiO_3$, however, reports of ferroelectric switching are rare [3] and experimental consensus on the nature and stability of the strain-induced ferroelectric phase is lacking. We here present a detailed study of the electrical properties of a series of epitaxial metal-$SrTiO_3$-metal heterostructures with $SrTiO_3$ coherently strained up to -3% compressive strain. We find that although our samples show no evidence of ferroelectricity down to 10 K, they exhibit a rich electrical activity with a strong temperature and time dependence. To explore the temporal aspect of the underlying processes we perform transient capacitance measurements and find a thermal crossover between different regimes with distinct mechanisms. Finally, we discuss the possible origins of the observed non-equilibrium behavior within the framework of defect-mediated internal fields in capacitors.

References:

[1] Pertsev et al., Phys. Rev. B, 61, 2 (2000)
[2] Haeni et al., Nature, 430, 7001 (2004)
[3] Jang et al., Phys. Rev. Lett., 104, 19 (2010)