Novel functionalities at twin domain crossings

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In ferroelectrics, domain walls are thin interfaces separating regions with different orientations of electric polarization, either along the same crystalline axis (180° domain walls), or as ferroelastic twins. The domain walls can present physical properties quite different from the surrounding domains, allowing them to be used as active components in future device applications.

Recent studies of domain walls using scanning probe microscopy have focused on mapping their response to different parameters such as temperature, applied pressure and electric field, in order to understand their structure-property relationships. In particular, the role of high strain gradients present at ferroelectric twins has been shown to enhance their electrical conduction [1] and can lead to complex rotational polarization textures [2, 3].

Here, I will present our investigation of ferroelastic twin domains (90° domain walls) in epitaxial $PbTiO_3$ thin films grown on $SrTiO_3$, explored with scanning probe microscopy. Our results suggest a complex polarization structure, with unique mechanical response distinct from the surrounding ferroelectric phase, and enhanced electrical conduction.

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[2] Catalan, G., et al, Nat. Mat. 10, 963 (2011).
[3] Cao, Y., et al, Appl. Phys. Lett. 110, 202903 (2017).