Local Writing and Characterization of Individual Charged Conducting Domain Walls in y-cut $LiNbO_3$ (MgO 5% mol) Single Crystals

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Domain walls in ferroelectrics are regions that delineate different polar domain variants, with a local structure distinct from that of the bulk crystal. The domain walls' distinct functional properties that arise are particularly exciting as the manipulation of domain walls can be done at will without the addition of new material. These walls can have varying strain, electrical and optical responses, so control over wall behavior allows these properties to be locally tuned. We are particularly interested in charged domain walls (CDWs) in y-cut lithium niobate, which can have many orders of magnitude greater conductivity than the bulk crystal. The locally modifiable electronic properties of these single crystals could allow them to play the role of various circuit components depending on their domain wall structure, with potential applications in malleable nano-electronics.

Substantial work has been done on measuring the conductivity of lithium niobate CDWs [1], and separate experiments have been performed to investigate localized domain wall control [2]. The missing link has been combining these areas of research, and providing deeper quantitative insight into conduction mechanisms at charged domain walls. We present localized writing of conducting CDWs with comprehensive positional control; measurements of conduction of individual written CDWs using electrodes as well as scanning probe microscopy; evidence for the alteration of room temperature conduction in CDWs through thermal activation of otherwise bound defect charges and finally local investigations of carrier densities and mobilities within domain walls via measurement of the potential induced by the Hall Effect [3].

These results provide a comprehensive body of empirical evidence to test contemporary hypotheses concerning the physics of domain wall conduction. We examine the relation between screening charges and active charge carriers in CDWs and the consistency of our findings with small polaron hopping as a conduction mechanism.

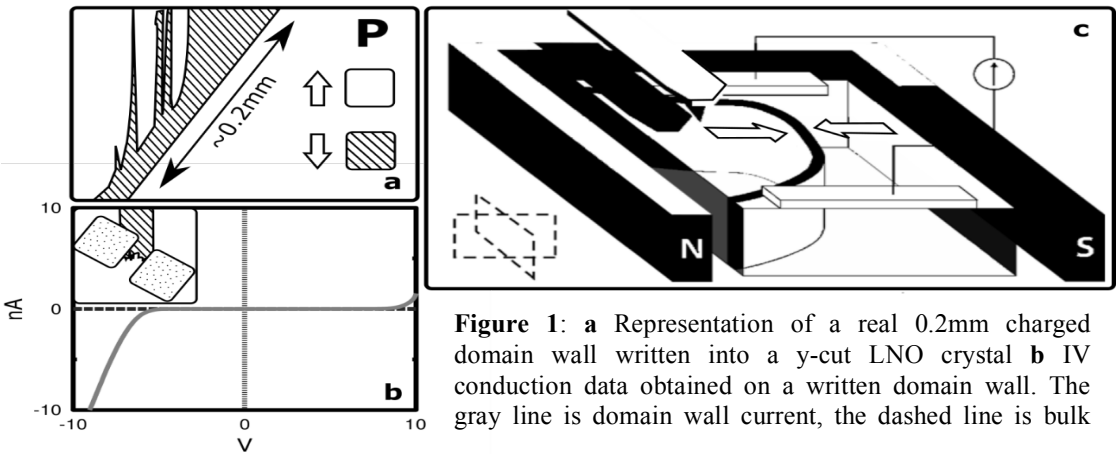

Figure 1: **a** Representation of a real 0.2mm charged domain wall written into a y-cut LNO crystal **b** IV conduction data obtained on a written domain wall. The gray line is domain wall current, the dashed line is bulk

References:
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