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Superdomain dynamics in single-crystal $BaTiO_3$ lamellae RAYMOND MCQUAID, LEO MCGILLY, Queens University Belfast, PANKAJ SHARMA, ALEXEI GRUVERMAN, University of Nebraska, Lincoln, MARTY GREGG, Queens University Belfast — In the1950's early studies pioneered by Merz established that 180° domain reversal in bulk $BaTiO_3$ could be described by a 3-stage switching process [see H. L. Stadler, Ferroelectrics 137, 1992]. This involved formation of a reversed domain nucleus, forward growth of a needle shaped domain towards the opposite electrode followed finally by sideways expansion. In a recent study [R. G. P. McQuaid, Nat. Comms. 2, 2011] we used Piezoresponse Force Microscopy (PFM) to monitor the switched domain states that developed in single-crystal $BaTiO_3$ slices machined (by Focused Ion Beam) to thin film thicknesses and incorporated into a coplanar geometry. We found that switched states are constrained to exist within a rigid framework of ordered ferroelastic stripe domains. Surprisingly, we see that switching occurs solely by the movement of a complex 180°-type boundary which separates 'bundles' of these domain stripes. We see that it is at the collective 'superdomain' level, rather than for individual domains, where the classic Merz nucleation and growth modes are observed. We use PFM imaging to track the realtime boundary position during switching and attempt model fits to understand its field driven dynamics.

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