Shapes of Isolated Domains in Uniaxial Ferroelectrics

Vladimir Shur1

1School of Natural Sciences and Mathematics, Ural Federal University, Russia

e-mail: vladimir.shur@urfu.ru

The variety of domains shapes appeared in uniaxial ferroelectrics will be presented, classified and discussed using kinetic approach based on analogy between domain structure evolution and phase growth during first-order phase transformation. Recent investigations allowed revealing metastable domain shapes stabilized by bulk screening, which can be divided into: (i) circular shapes, (ii) regular polygons, (iii) irregular polygons, (iv) irregular shapes. The domain growth by step generation and kink motion has been discussed [1] with nucleation probabilities defined by local value of the sum of external field and residual depolarization field. This knowledge is applied for micro- and nano-domain engineering.

The complication of domain shape due to ineffective screening was demonstrated experimentally and by computer simulation [1]. Step nucleation variants have been considered: (a) stochastic - with equiprobable position of nucleation sites, (b) determined - with step generation at polygon vertexes and anisotropic kink motion. Stochastic nucleation creates circular domains, whereas determined nucleation - regular polygons. The convex polygons with oriented walls appeared for effective screening: (a) hexagons and triangles for C3v symmetry (LiNbO3 and LiTaO3), (b) squares for C4 (SrxBa1-xNb2O6), (c) rectangles for C2 (KTiOPO4) [2]. Screening retardation allowed formation of stars and irregular polygons [3]. The fast restoration of the initial domain shapes after merging was attributed to observed formation of the super-mobile walls [4]. The stochastic nucleation at elevated temperatures stimulates formation of fractal and dendrite shapes [5,6] created by: (i) discrete switching with subsequent merging, (ii) domain shrinkage, (iii) artificial dielectric layers [7].

The equipment of the Ural Center for Shared Use “Modern nanotechnology” Ural Federal University was used. The research was made possible by RSF (Grant 14-12-00826).

References

1. V. Ya. Shur. J. Mater. Sci., **41**, 199 (2006)

2. V. Ya. Shur et. al., Appl. Phys. Lett., **109**, 132901 (2016)

3. A. I. Lobov et. al., Ferroelectrics, **341**, 109 (2006)

4. V.Ya. Shur et. al., Ferroelectrics, **360**, 111 (2007)

5. V. Ya. Shur et. al., J. Appl. Phys., **112**, 104113 (2012)

6. V. Ya. Shur et. al., J. Appl. Phys., **119**, 144101 (2016)

7. V. Ya. Shur and A. R. Akhmatkhanov, Phil. Trans. R. Soc. A, **376**, 20170204 (2018)