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Correlation of wall velocity and tip curvature radius of dendrite domain in lithium niobate

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Recently, the unusual growth of dendritic ferroelectric domains during polarization reversal in uniform field has been demonstrated in single crystals of a uniaxial ferroelectric lithium niobate $LiNbO_3$ [1]. Two necessary conditions have been realized for dendritic domain growth: (1) existence of the artificial dielectric layer deposited on the polar surface leading to retardation of the bulk screening process and (2) switching at the elevated temperature resulting in stochastic nucleation. It was shown that domain shape depends substantially on the applied electric field.

The presented work is devoted to experimental study of the domain shape evolution in terms of correlation between the curvature radius (ρ) and velocity (v) of the tip of main dendrite branch. The growth rate was measured by analysis of the video record of the domain structure evolution during polarization reversal process recorded with high temporal resolution at z-cut congruent lithium niobate single crystals. The *ex situ* imaging of the static domain structure revealed by selective chemical etching after partial polarization reversal using scanning electron microscopy allowed to measure the curvature radius.

It was shown that well-known stability condition for classical dendrites $v\rho^2 = const$ [2] does not hold in studied experimental conditions. The obtained fact can be attributed to significant input of the tip-splitting mechanism of dendrite growth [3].

The phase-field simulation of anisotropic dendrite growth for C_{3v} crystal symmetry was used to study the shape transformation and correlation between tip velocity and curvature radius. The modelling was based on the analogy between self-organized growth of ferroelectric domains and new phase during the first order phase transition. The similar behaviour of dendrite shape evolution has been obtained for properly chosen model parameters.

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1. V.Ya Shur, A.R. Akhmatkhanov, *Philos. Trans. Royal Soc. A* **376,** 20170204 (2018).
2. J.S. Langer, H. Müller-Krumbhaar, *Acta Metallurgica* **26**, 1681 (1978).
3. P.K. Galenko, V.A. Zhuravlev, *Physics of dendrites* (World Scientific), (1994).