Domain Shape Instabilities and Fractal Domain Growth in Uniaxial Ferroelectrics in Highly Non-equilibrium Switching Conditions

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The kinetic approach to evolution of the ferroelectric domain structure, based on the analogy with the first order phase transition, allows to explain the formation of the metastable domain structures with energy essentially exceeding the equilibrium ones. The screening of the depolarization field stabilizes any non-equilibrium domain pattern. It was shown that the screening retardation changes drastically the domain structure evolution. The highly non-equilibrium switching conditions characterized by ineffective bulk screening lead to formation and evolution of the self-assembled nanodomain structures [1,2]. The domain structure evolution has been studied by joint application of optical microscopy, confocal Raman microscopy, scanning electron microscopy and piezoelectric force microscopy for domain visualization in the uniaxial ferroelectrics lithium niobate $LiNbO_3$, lithium tantalate $LiTaO_3$, lead germanate $Pb_5Ge_3O_{11}$, and relaxor ferroelectric strontium-barium niobate $Sr_xBa_{1-x}Nb_2O_6$. The role of the residual depolarization field in formation of the self-assembled fractal micro- and nanodomain structures have been demonstrated [1-3]. The effects of domain wall shape instabilities and formation of the nanodomains in front of the moving walls have been discussed. The special attention has been paid to formation of the self-assembled nanoscale and dendrite domain structures in highly non-equilibrium switching conditions [3]. All obtained results have been considered in framework of the described kinetic approach to the domain structure evolution.

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