# Domain-wall motion for slowly varying electric field

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The problem of the domain-wall motion near a ferroelectric/dielectric interface is studied using the Landau-Ginzburg-Devonshire three-dimensional phenomenological approach [1,2]. It is assumed that the characteristic time of the external field varying is significantly greater than the ferroelectric relaxation time. In our investigations the axially symmetric ferroelectric is considered.

The system of equations describing the potential $\varphi$, electric field $\mathbf{E}=-\nabla\varphi$, polarization $\mathbf{P}$, and displacement $\mathbf{D}=\varepsilon_0\mathbf{E}+\mathbf{P}$ ($\varepsilon_0$ is the universal dielectric constant) can be written as

$$\begin{gathered} \nabla\cdot\mathbf{D}=\rho \\ r\frac{\partial\mathbf{P}}{\partial t}-g\Delta\mathbf{D}+a\mathbf{P}+b\mathbf{P}^3=\mathbf{E} \end{gathered} . \tag{1}$$

Here $r,g,a,b$ are constants, $\rho$ is the electric charge density. For uniquely determination of the sought-for values in (1) it is necessarily to introduce the conditions of the decrease at infinity as well as boundary conditions. Due to the large value of dielectric permittivity of ferroelectric materials, these conditions can be defined as

$$E_z\Big|_{z=0}=E_0(r,t), \tag{2}$$

where $(r,z)$ is the cylindrical coordinate system, $E_z$ is the corresponding component of the electric field vector, and $E_0(r,t)$ is the specified function (an external field).

In this work, we have analyzed the asymptotic solution of the problem (1,2). One may conclude that the dependence of the domain-wall motion velocity from external field is complicated enough to be approximated by a power or exponential function. It is shown that the evolution of charge density with time to be of great importance to the domain-wall motion description.

1. A. N. Morozovska, E. A. Eliseev, S. L. Bravina, and S. V. Kalinin , *Journal of applied physics* **110**, 052011 (2011).
2. E. A. Eliseev, A. N. Morozovska, G. S. Svechnikov, E. L. Rumyantsev, E. I. Shishkin, V. Y. Shur, and S. V. Kalinin, *Physical Review B* **78**, 245409 (2008).

I prefer oral presentation.

**ISFD-12** Section 10:

Theory, computer simulations and modeling of domain structures and domain walls.