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Surface effect on the domain wall structure in ferroelectric film

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Study results of the surface effect on the spontaneous polarization vector behavior in the domain bound of a ferroelectric film are presented. The presence of a surface has been shown to result in an inhomogeneous polarization distribution over the film thickness. Analytical expressions for the polarization fields have been derived as well as for dependence thereof on the film thickness.

В работе представлены результаты исследования влияния поверхности на поведение вектора спонтанной поляризации в доменной границе сегнетоэлектрической пленки. Показано, что наличие поверхности приводит к неоднородному распределению поляризации по толщине пленки. Получены аналитические выражения для полей поляризации и их зависимости от толщины пленки.

The number of publications dealing with physical properties of ferroelectric (FE) films is growing during last few years as an avalanche. Most of such studies are associated with investigations in the domain switching processes under electric field actions on the sample. This interest in such studies due to that high-quality FE films (which are succeeded to be manufactured only recently) are high-efficiency elements of good promise for memory devices of new computer generation.

The operating efficiency of memory devices based on FE film elements is defined by the fastness and completeness of polarization switching under the electric field direction change as well as by the number of the polarization switching cycles occurring without any degradation of the element (film) properties. The operating parameters of the elements are define to a great extent by interaction mechanism of domain bounds with crystal lattice defects (both point and extended ones). The structure of the domain bound itself is to be known to simulate such processes. This knowledge is very limited to date. This is associated to a considerable extent with the complexity of the FE domain bound and the insufficient attention given to studies thereof.

The purpose of this work is to study the domain bound structure in a ferroelectric film over the whole film thickness under account for surface effects. Similar investigations were performed for magnetic films but there were no such works on FE films. This is due to that, on the one hand, the high-quality thin films were not available, so it was impossible to compare the results calculated using specific physical models with experimental data; on the other hand, to that in ferroelectrics, unlike magnetics, the domain bound thickness is much smaller than the film one, thus, other approaches