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Domains and Hysteresis Loops in Ferroelectric Thin Films with Metallic and Semiconductor Electrodes A.M. BRATKOVSKY, Hewlett-Packard Labs, Palo Alto, California 94304, A.P. LEVANYUK, UA Madrid, Spain — Detailed thermodynamic description of the ferroelectric (FE) thin films with metallic and semiconductor electrodes is presented. We show that imperfect screening by the electrodes results in uncompensated depolarizing field and leads to a tilt of the hysteresis loops, as observed experimentally. We solve for the domain instability analytically and find a simple criterion for stability of homogeneously polarized state in thin films with realistic metallic electrodes. In most cases the film breaks into domains, and they can exist in near cubic (perovskite) ferroelectrics down to "atomic" thicknesses (one unit cell thick). Domain structures under bias voltage are investigated. In the case of semiconductor electrodes the screening is poor at small values of polarization P and highly nonlinear at larger P close to a spontaneous polarization in the bulk. This formally allows for the "Batra-like" jumpwise transition at lowering temperature, which is not observed since it is preempted by domain instability. Additional boundary conditions [1] modify the above behavior, but mainly for a homogeneous state. The unusual phase behavior in cases of symmetric and asymmetric boundary conditions is discussed together with available experimental data.
[1] A. M. Bratkovsky and A. P. Levanyuk, Phys. Rev. Lett. **94**, 107601 (2005) and to be published.

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