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Size Effects in Ferroelectric Thin Films: The Role of 180 degree domains RAJEEV AHLUWALIA, Institute of Materials Research and Engineering, DAVID SROLOVITZ, Department of Physics, Yeshiva University — The depolarization fields set up to due to uncompensated surface charges in a ferroelectric thin film can suppress the ferroelectric phase below a critical size. However, recent experiments show that 180 degree domain structures can help to stabilize ferroelectricity in films which are as small as about 3 unit cells thick. We study the influence of these domain structures on the size dependent properties of ferroelectric thin films using a Ginzburg-Landau theory. The model incorporates the effect of depolarization field by considering non-ferroelectric passive layers at the top and bottom surfaces. It is shown that the wavelength of the 180 degree domains decreases as the film thickness is reduced and eventually the film abruptly becomes paraelectric below a critical size. It is also shown that 180 degree domains appear during the process of polarization switching causing a time dependent relaxation of the remnant polarization , consistent with recent experiments. Further, it is observed that the depolarization induced domain wall motion significantly alters the shape of the polarization vs electric field (P-E) loops at small thicknesses.

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