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Surface morphology of $PbTiO_3$ films on $SrTiO_3$ (001) K. LATIFI, CAROL THOMPSON, Physics Dept., Northern Illinois University, D. D. FONG, G. B. STEPHENSON, P. H. FUOSS, J. A. EASTMAN, F. JIANG, Materials Science Division, Argonne National Laboratory, S. K. STREIFFER, R.-V. WANG, Center for Nanoscale Materials, Argonne National Laboratory — Strain relaxation is a ubiquitous process in the synthesis of heteroepitaxial films. Films deposited onto a substrate with a small lattice parameter mismatch will often initially form as coherently strained (lattice matched) layers. As the film grows and exceeds a critical thickness, the stored elastic energy is released through the creation of crystal defects such as misfit dislocations. Even before dislocation introduction, epitaxial strain can lead to morphological instabilities of the growth interface, with the formation of mounds. We use atomic force microscopy to investigate surface morphology related to strain relaxation during the epitaxial growth of $PbTiO_3$ films ranging from 10 nm to 385 nm in thickness on $SrTiO_3$ (001) substrates. The ferroelectric phase transition temperature of coherently strained $PbTiO_3$ films is increased, but also depends on thickness. Therefore, for some range of typical growth temperatures of organo-metallic vapor phase epitaxy, it is possible for the film to undergo a paraelectric to ferroelectric phase transition during growth. This could lead to additional mechanisms of strain relaxation becoming active during growth.

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