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Dielectric Permittivity and Tunability of Ferroelectric Bilayers and Multilayer Heterostructures S. P. ALPAY, I. B. MISIRLIOGLU, G. AKCAY, S. ZHONG, Institute of Materials Science, University of Connecticut, Storrs, CT, J. V. MANTESE, Delphi Research Laboratories, Shelby Township, MI, M. W. COLE, U.S. Army Research Laboratory, Aberdeen Proving Ground, MD — Ferroelectric multilayers and superlattices have gained interest for many applications in the telecommunications industry. A thermodynamic analysis is presented to demonstrate that ferroelectric multilayers interact through internal elastic, electrical, and electromechanical fields and the "strength" of the coupling can be quantitatively described using Landau theory, theory of elasticity, and principles of electrostatics. The modeling indicates that the electrostatic coupling between the layers leads to the suppression of ferroelectricity at a critical paraelectric layer thickness for ferroelectric-paraelectric bilayers. This bilayer is expected to have a huge dielectric response and tunability at this critical thickness. We carry out a numerical analysis for prototypical $BaTiO_3$-$SrTiO_3$ bilayers (40 to 800 nm total thickness) as a function of $SrTiO_3$ fraction. There exists a critical fraction of $SrTiO_3$ at which the polarization is suppressed due to the depolarization field and a large dielectric response is predicted. It is shown that this critical fraction decreases with decreasing total bilayer thickness indicating that the interfacial effects are more pronounced in thinner bilayers.

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