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Effect of Mechanical Boundary Conditions and Thermal Stresses on the Electrocaloric and Pyroelectric Properties of Ferroelectric Films JIALAN ZHANG, GEORGE. A. ROSSETTI, JR., S. PAMIR ALPAY, Institute of Materials Science, University of Connecticut — We use a non-linear thermodynamic model to describe quantitatively the electrothermal response of perovskite ferroelectric thin films under different electrical, thermal and mechanical boundary conditions. A comparison of ferroelectric materials such as $BaTiO_3$, $PbTiO_3$, and $SrTiO_3$ illustrates the influence of composition and lateral clamping effect on the electrocaloric properties. The theoretical analysis of a variety of (001)-textured polycrystalline ferroelectric thin films on IC-friendly substrates such as Si and sapphire shows that the thermal stresses that develop during processing shift the zero-field Curie temperature, and have a significant influence on the pyroelectric properties of thin film ferroelectric materials. We also demonstrate that the maximum in the electrocaloric properties can be shifted to a working temperature of interest by adjusting the deposition/processing temperature. These results provide insights on how to optimize pyroelectric and electrocaloric properties.

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