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Shock induced phase transitions and current generation in ferroelectric ceramics[1] VINAMRA AGRAWAL, Auburn University, KAUSHIK BHATTACHARYA, California Institute of Technology — Ferroelectric materials are used as ferroelectric generators to obtain pulsed power by subjecting them to a shock loading. The impact induces a phase transition and at high impact speeds, dielectric breakdown. Depending on the loading conditions and the electromechanical boundary conditions, the current or voltage profiles obtained vary. We explore the phenomenon of large deformation dynamic behavior and the associated electro-thermo-mechanical coupling of ferroelectric materials in adiabatic environments. Using conservation laws, Maxwell's equations and second law of thermodynamics, we obtain a set of governing equations for the material and the driving force acting on the propagating phase boundary. We also account for the possibility of surface charges on the phase boundary in case of dielectric breakdown which introduces contribution of curvature of the phase boundary in the equations. Next, the governing equations are used to solve a plate impact problem. The Helmholtz energy of the material is chosen be a combination of piecewise quadratic potential in polarization and thermo-elastic material capable of undergoing phase transformation. We obtain current profiles for short circuit boundary conditions along with strain, particle velocity and temperature maps.

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Vinamra Agrawal
Auburn University

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