Abstract Submitted
for the 4CF07 Meeting of
The American Physical Society

Structural phase transformations with plasticity using the Landau-Ginzburg theory ROMAN GRÖGER, TURAB LOOKMAN, Los Alamos National Laboratory — Technologically useful materials, such as shape memory alloys (NiTi, FePd, U_6Nb) undergo displacive transformations from a high-temperature austenitic phase to a low-temperature, lower symmetry martensitic phase. The Landau-Ginzburg approach has been successfully applied to describe these transformations when the associated strains are purely elastic. In this work we consider both elastic and plastic strains and generalize the Landau-Ginzburg theory to also describe the elastic-plastic regime. In our model the elastic strains satisfy the Saint Venant compatibility constraints and, provided they are known, the applied stress can be calculated from the generalized Hooke's law. When this stress reaches the yield stress, the plastic strains evolve according to relations derived from the model of von Mises plasticity that we complement by a simple phenomenological model of strain hardening. The unloading proceeds purely elastically and the last stress attained is identified as the yield stress for subsequent reloading. We illustrate our approach with a two-dimensional version of the cubic to tetragonal structural transformation in FePd.

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Date submitted: 04 Sep 2007