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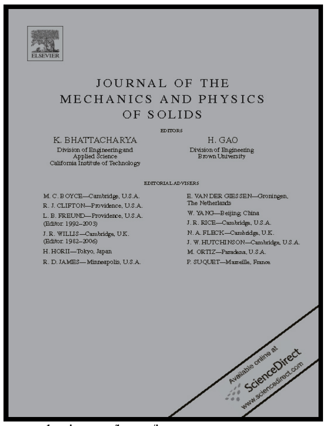


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# Interaction between phase transformations and dislocations at the nanoscale. Part 2. Phase field simulation examples

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**Abstract**

The complete system of phase field equations for coupled martensitic phase transformations (PTs), dislocation evolution, and mechanics at large strains is presented. Finite element method (FEM) is utilized to solve this system for two important problems. The first one is related to the simulation of shear strain-induced PT at the evolving dislocation pile-ups in a nanosized bicrystal. Plasticity plays a dual part in the interaction with PT. Dislocation pile-ups produce strong stress tensor concentrators that lead to barrierless martensite (M) nucleation. On the other hand, plasticity in the transforming grain relaxes these stress concentrators suppressing PT. The final stationary M morphology is governed by the local thermodynamic equilibrium, either at the interfaces or in terms of stresses averaged over the martensitic region or the entire grain. This is very surprising because of strong heterogeneity of stress fields and is in contrast to previous statements that phase equilibrium conditions do not enter the description of strain-induced PTs. The second problem is devoted to martensitic plate propagation through a bicrystal during temperature-induced PT. For elastic growth (without dislocations) and a large thermal driving force, a complex transformation path with plate branching and direct and reverse PTs is observed, which still ends with the same stationary nanostructure as for a smaller driving force and a traditional transformation path. Sharp grain boundary arrests plate growth at a relatively small driving force, exhibiting an athermal friction. For elastoplastic growth, the generation of dislocations produces athermal friction and arrests the plate below some critical driving force, leading to a morphological transition from plate to lath M. The width of the martensitic plate increases in comparison with elastic growth



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