Small strain elasto-plastic phase-field model based on the mechanical jump conditions

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ABSTRACT

In numerical simulations of metallic components under mechanic load, the material is commonly considered as homogeneous. This assumption is reasonable and feasible for simulations on the macroscopic length scale. Looking at metallic materials on the mesoscopic scale, the apparently homogeneous materials consist of a large number of single crystals, pores and inclusions. Especially in material science the observation of materials on the mesoscopic scale is very important. Here the morphological evolution of the micro-structure during solid-solid phase transformation processes, under the influence of different thermodynamic fields, is of growing interest. For the simulation of processes like the martensitic or the bainitic transformation, which cause Twinning Induced Plasticity (TWIP) or Transformation Induced Plasticity (TRIP) on the macroscopic length scale, the phase-field method offers great opportunities. Within the phase-field method, the quantitative calculation of the mechanical energies, especially in the diffuse interface region, is a challenge.

This talk presents an extension of the generalized phase-field approach for multiphase and multicomponent systems [1] coupled with the phase-field elasticity model based on the mechanical jump condition [2], by an elasto-plastic model for small deformations, which fulfills the mechanical jump conditions, namely the force balance and the Hadamard jump condition, even within the diffuse interface region. In the interest of simplification a Prandtl-Reuss model combining a von Mises yield function with isotropic linear hardening and a two step return mapping algorithm is used.

REFERENCES

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