On the Coupling of Crystal-Plasticity and the Phase-Field Method

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Abstract

In the recent past, the incorporation of elastic energy in the phase-field method has led to a broad amount of studies on the evolution of microstructures. In this context, the stresses stem obviously not only from external loads (i.e. hot-rolling), but more important from transformations strains. However, in a total elastic framework stresses beyond the yield limit of metals can be reached such that the predicted elastic energies are not physically limited and mispredict transformation driving forces. The consideration of dislocation plasticity hence becomes necessary in order to obtain realistic microstructure evolution from phase-field simulations.
In this talk a coupling concept of plasticity and the phase-field method is presented. A special emphasis is put on the formulation of a crystal-plasticity model for small and finite strains using dislocation densities as a primary state variable. Finally the model's application towards the simulation of martensitic phase-transformations in steel is motivated.