An integrated crystal-plasticity and phase-field simulation framework

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The quantitative simulation of phase transformation or grain growth processes by means of the phase-field method requires the best possible knowledge of the underlying energy landscape. As such, the elastic energy has frequently been considered in earlier publications[1]. However, high internal stresses induced by transformation strains or external deformations might be limited by irreversible deformations, i.e. dislocation slip or twinning. In addition, plastic deformations change the local defect density which represents a critical factor in static and dynamic recrystallization or martensitic phase-transformations.

In this talk the integration and application of a phenomenological, non-local crystal plasticity model in the open-source, multi-phase-field framework *OpenPhase* is presented. Starting with our formulation[2] to consider large deformations in the existing phase-field code (more details are intended to be given in a separate talk at this conference) using a spectral solver to solve the mechanical boundary value problem, details about the plasticity–phase-field coupling scheme are given. Strategies to consider grain boundary–dislocation interaction and its influence on the transformation kinetics are critically discussed with the help of illustrative microstructures.

[1] Steinbach and Apel, *Physica D*, **207**, 153-160, (2006)
[2] Borukhovich et al., *Modelling Simul. Mater. Sci. Eng*, **22**, 034008, (2014)