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Towards a robust model for metastable austenitic steel

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Introduction
Because of their superior properties advanced high strength steels (AHSS), such as steels with transforming metastable phases, are widely used for various applications in the range from automotive parts to medical equipment and domestic appliances. These materials exhibit complex behavior: their engineering scale response to mechanical loading during processing and service may be highly dependent on the microstructural features, whereas microstructural properties may evolve during the mechanical loading, e.g. martensitic transformation. The project aims to predict the behavior of metastable austenitic steels and provide input for optimization of the production processes.

Method and Micromechanical Model
The micro-level single grain transformation model is employed within the multi-scale computational framework (Fig. 2).

Results
The single grain model was successfully implemented within three-dimensional non-linear finite element framework and tested on various homogeneous loading cases, e.g. uniaxial tension test (Fig. 3, 4).

Conclusions and Future Work
Based on the results of the simulations we may conclude that

- The model captures dependency on grain orientation
- The variation of grain orientations is crucial for obtaining the realistic response for uniaxial test simulations with respect to martensitic transformation

The following future work directions have been identified:

- Enhancement of the model: incorporate the influence of the plastic deformation on the transformation barrier
- Incorporation of polycrystalline behavior (e.g. Taylor-type approach) into the model
- Application of the model to Sandvik NanoflexTM material: comparison of simulations with experiments
- Identification of major factors influencing the transformation behavior and overall material response, comparison of simulations: RVE-type vs. Taylor-type model