Multiphase-field modeling of martensitic phase transformation in an EBSD-based dual-phase microstructure

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ABSTRACT

Automotive industry, like other industrial sectors, demands for dual-phase steel due to the attractive combination of high strength and good formability.

The high strength is achieved by the martensitic phase which arises during quenching through displacive phase transformation process from austenite. The resulting microstructure and their mechanical properties are significantly characterized by the applied process parameters. Hence, a better understanding of their effects are fundamental to design a material with desired properties.

The phase-field method has emerged as a powerful tool in order to simulate grain boundary motion phenomena. In case of martensitic phase transformation, a special challenge lies in considering the effect of grain boundaries in polycrystals since a martensitic phase should not cross them. In accounting for this requirement, we present a multiphase-field model based on the model of Nestler et al. [1]. Each grain contains its own set of order parameters consisting of an austenitic phase and a defined arbitrary number of martensitic variants. The mechanical part is solved according to our recently published work [2], which is capable of fulfilling the mechanical jump conditions at the interface and uses configurational forces as mechanical driving forces for phase transformations.

We present simulations of martensitic phase transformation in an EBSD-based dual-phase microstructure. The austenitic grains transform into martensite depending on their orientation and the chosen process parameters while the ferritic grains remain inert. We discuss the nucleation and propagation behavior of the martensitic variants and the resulting stress distribution in the dual-phase microstructure.

REFERENCES

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