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Flow stress and microstructure models of alloys

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ABSTRACT

Describing the material behavior is crucial in simulations of thermo-mechanical manufacturing processes. The material response may then be a complex function of loading conditions and the current microstructure of the material. This is particular true of the plastic properties of the material. The microstructure is a function of the previous thermo-mechanical history of the material, the mechanical part often ignored. The best approach for describing the material response in this context is to combine microstructure and flow stress models.

The paper presents an approach based on mechanism-based plasticity combined with flow stress models. The models are applicable to large-scale models. The models have been applied to stainless steels (AISI 316 and AISI 420), aluminum alloys (AA5083), as well as Ti-alloys (Ti-6Al-4V) and superalloys (Alloy 718). The resulting flow stress models are shown together with application of them in a number of manufacturing processes.

KEYWORDS: flow stress, microstructure, dislocation density, manufacturing, finite element simulation