EN EFFECT OF MICROSTRUCTURE AND HYDROGPORES ON THE MECHANICAL BEHAVIOUR IN AL7%Si0.3%MG STUDIED BY A COMBINED PHASE-FIELD MICROMECHANICAL APPROACH

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Abstract

For the casting of complex shaped parts it is an important issue to assure the required mechanical material properties, regardless the fact that the local cooling conditions and therefore the microstructure locally varies. In this contribution, we will discuss a combined approach, linking phase-field simulations to micromechanical calculations, in order to numerically elucidate the interrelations between process, microstructure and mechanical behavior.

A general multicomponent/multiphase-field model, coupled to a thermodynamic and mobility database has been used to simulate the microstructure evolution in an A356 aluminum alloy during solidification. The microstructure is composed of primary Al-dendrites, Si-lamellae, and small Mg2Si-precipitates. The simulated morphologies and structure sizes fairly agree with those measured for a reference casting. Numerical constraints caused by the multiscale nature of the microstructure will be discussed.

A displacement-controlled numerical tension test is performed in order to control the deformation process during the predefined time interval. For the micromechanical calculations a damage evolution-based model has been applied. The modified Rice&Tracey damage parameter is adapted to evaluate the damage evolution in different microstructures. Furthermore, the effect of interdendritic solidification pores is investigated and is compared with a non-void afflicted structure.

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