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Coupling micro- and macroscopic levels in a sintering model

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ABSTRACT

Sintering is a powder metallurgy process consisting in consolidation of loose or weakly bonded powders at elevated temperatures, close to the melting temperature with or without additional pressure. Sintering is a complex process affected by many factors. Modelling can be very helpful in prediction of the process performance and its optimization. There are different approaches in modelling of sintering processes, ranging from continuum phenomenological models to micromechanical and atomistic ones. At sintering, processes at different levels interact with one another, therefore multiscale modelling reflects a multi-scale nature of sintering.

In this work, a two-scale model of sintering, coupling the microscopic and macroscopic models, will be considered. The micromechanical model of sintering have been developed in the framework of the discrete element method [1], while the macroscopic model has been formulated in the finite element method, thus coupling of the models corresponding to the two scales constitutes at the same time coupling between the discrete and finite element methods.

Coupling of the microscopic and macroscopic models is performed by appropriate interscale transfers. The present work will be focused on the transfer from the micro- to the macroscopic level. The discrete element method simulation of sintering will provide parametric information to the finite element model macroscopic model of sintering. Micro-macro relationships for strains, stresses and constitutive parameters will be derived. The constitutive models at both scales incorporate elastic and viscous deformations. The micro-macro constitutive relationships for elastic and viscous parameters will be determined for real process of compaction and hot pressing of NiAl powder [2].

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