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DISCRETE ELEMENT MODELLING OF MULTIPHYSICS PHENOMENA IN POWDER SINTERING PROCESSES

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ABSTRACT

Discrete element modelling of mechanical, thermal and electrical phenomena in powder sintering processes will be presented. Sintering is a key stage of many powder metallurgy techniques in which bulk material is consolidated from loose or weakly bonded powder at an elevated temperature close to the melting point. Sintering can be performed without pressure (free sintering) or with pressure (pressure-assisted sintering). Non-conventional sintering technologies such as electrical current-activated sintering (ECAS) have also been developed.

This work is focused on modelling hot pressing (HP) which belongs to pressure-assisted sintering techniques and the ECAS process. The discrete element method employing spherical particles will be used. Spherical discrete elements represent powder particles, and the discrete element method is a suitable framework for micromechanical modelling of powder sintering processes. The mechanical model is based on the original viscoelastic model developed in [1], while the thermal and electrical models employ the formulation presented in [2]. A complete process, including heating, pressing and cooling, will be simulated. Thermomechanical and thermoelectrical coupling effects will be considered.

The discrete element model provides insight into the sintering mechanisms at the microscopic level as well as allows us to evaluate equivalent macroscopic properties using appropriate averaging methods. Thus, the developed model can be used as an element of a multiscale model.

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