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Discrete element modelling of hot pressing process

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The technological method of hot pressing is commonly used to manufacture novel materials with wide application range. Hot pressing process consists of two stages occurring simultaneously: powder compaction and sintering, which involves high-temperature consolidation of loose or weakly bonded powders. This is a complex process affected by many factors therefore modeling of hot pressing is one of the most challenging problems in material modeling.

This work presents an original numerical model of hot pressing [1] developed within a framework of the discrete element method (DEM). The DEM assumes that material can be modelled by a large assembly of discrete elements (particles) of spherical shape interacting among one another by contact forces taking into account such effects as viscosity, elasticity or cohesion. The DEM model is capable to represent the microstructure of the material during sintering (Fig. 1) and its evolution. Particle interaction model consider formation and growth of cohesive bonds between grains during sintering. The DEM model has been applied to simulation of hot pressing of NiAl powder (Fig. 2). Numerical model has been calibrated and validated using own experimental results. It has been shown that the model properly represents macroscopic behavior of the material at the hot pressing process.
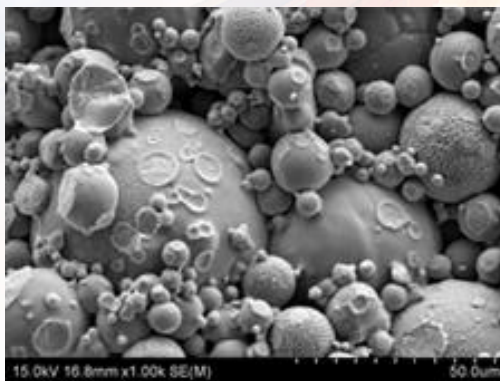

Fig. 1. Microstructure of NiAl material at an early stage of sintering.
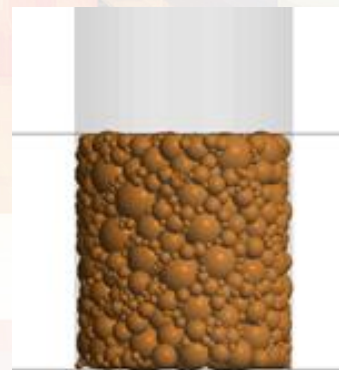

Fig 2. Discrete element model of NiAl sintering.

[1] Nosewicz, S., Rojek, J., Pietrzak, K. and Chmielewski M., "Viscoelastic discrete element model of powder sintering," Powder Technology, 246, 157–168 (2013).