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Simulation of low-pressure powder compaction using an elastoplastic discrete element model

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ABSTRACT

The discrete element method (DEM) is a powerful tool to model various granular materials. It is most often used assuming an elastic interaction between particles. It should be noticed, however, that the elastic contact model has a limited validity in some cases, for instance, in modelling of powder compaction in powder metallurgy processes. Even at low compacting pressure levels effects of material yielding can be observed [1]. Therefore a plastic material behaviour should be taken into account in the interaction model.

Two different elastoplastic contact models, the Walton-Braun model [2] with linear loading and unloading and the nonlinear Storåkers model [3] combined with the Hertzian elastic unloading, have been investigated experimentally and numerically. It has been demonstrated that the Walton–Braun is an efficient and sufficiently accurate model for the elastoplastic contact in the discrete element method using spherical particles. It has also been shown that the Storåkers model provides a good evaluation of the loading stiffness for the elastoplastic contact between two spheres undergoing plastic deformation induced by the contact.

The elastoplastic contact model has been applied to simulation of the powder compaction in a cylindrical die. Experimental results obtained for the intermetallic NiAl powder has been used for validation of the discrete element model. A good performance of the discrete element model has been shown.

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REFERENCES

[1] J. Rojek, S. Nosewicz, K. Jurczak, M. Chmielewski, K. Bochenek, and K. Pietrzak, “Discrete element simulation of powder compaction in cold uniaxial pressing with low pressure”, *Computational Particle Mechanics*, **3**, 513–524 (2016).
[2] O. Walton and R. Braun, “Stress calculations for assemblies of inelastic spheres in uniform shear”, *Aeta Mechanica*, **63**, 73–86 (1986).
[3] B. Storåkers, N. Fleck, and R. McMeeking, “The viscoplastic compaction of composite powders”, Journal of the Mechanics and Physics of Solids, **47**, 785–815 (1999).