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Multi-Particle Finite Element Modelling Simulation Based on Cohesive Zone Method of Cold Compaction Behavior of Laminar Al and NaCl Composite Powders

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Abstract : With the advantage of low volume density, high specific surface area, light weight and good permeability, porous aluminum material has the potential to be used in automotive, railway, chemistry and construction industries, etc. A layered powder sintering and dissolution method were developed to fabricate the porous surface Al structure with high efficiency. However, the densification mechanism during the cold compaction of laminar composite powders is still unclear. In this study, multi particle finite element modelling (MPFEM) based on the cohesive zone method (CZM) is used to simulate the cold compaction behavior of laminar Al and NaCl composite powders. To obtain its densification mechanism, the macro and micro properties of final compacts are characterized and analyzed. The robustness and accuracy of the numerical model is firstly verified by experimental results and data fitting. The results indicate that the CZM-based multi particle FEM is an effective way to simulate the compaction of the laminar powders and the fracture process of the NaCl powders. In the compaction of the laminar powders, the void is mainly filled by the particle rearrangement, plastic deformation of Al powders and brittle fracture of NaCl powders. Large stress is mainly concentrated within the NaCl powers and the contact force network is formed. The Al powder near the NaCl powder or the mold has larger stress distribution on its contact surface. Therefore, the densification process of cold compaction of laminar Al and NaCl composite powders is successfully analyzed by the CZM-based multi particle FEM.

Keywords : cold compaction, cohesive zone, multi-particle FEM, numerical modeling, powder forming
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