A DESIGN APPROACH FOR PREFORM PREDICTION

by

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ABSTRACT

In a typical powder metallurgical process such as cold or hot isostatic pressing, considerable time and effort are needed to predict the preform shape, given the geometry of the target shape, the details of the process and the material characteristics. The use of the Rational Process and Product Design ($R{\cdot}P^2D_{SM}$)[1] approach which includes CAD representation of the part geometry, material specification, manufacturing setup and the process simulation, greatly reduces the time in predicting the preform shape. It also enables the designer to foresee the variations in important parameters such as density and stress with respect to temperature and pressure when metal powders are consolidated. An expert system is being developed to contain heuristic rules which provides a means to predict the preform shape of a part by extrapolating the shape changes for similar parts in the knowledgebase. The heuristic rules are developed based on experiments in producing parts having simple and compound features by CIP/HIP processes. The geometry and topology of the target shape is input to the $R{\cdot}P^2D$ system using a solid modeling interface. With the specification of the material properties and the process method, the rulebase determines the required preform shape. An interative finite element analysis is performed on the preform shape predicted by this expansion rulebase to simulate the consolidation process. This iterative method improves the preform shape for net-shape part production. This work exemplifies the $R{\cdot}P^2D$ method for manufacturing processes with specific application to powder metallurgy.

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[1] Rational Process and Product Design - ($R{\cdot}P^2D_{SM}$) are Service Marks of CTC