Mathematical Model of Powder Materials Hot Pressing Based on Phenomenological Creeping Theory

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Abstract

The work is dedicated to elaboration of new mathematical model describing compaction kinetics of powder materials during hot pressure treatment. Possibility and expediency of using phenomenological creeping theory methods for powder metallurgy processes calculation are substantiated. Basic theses of powder materials creeping theory considering the presence of porosity are formulated and determining equations are deduced. Rated relations for determination of compaction parameters during hot pressing processes are obtained. Concrete calculation examples are given. It is shown that model equations at particular values of included parameters comes to well-known corroborated experimentally formulas. As a result that deduced equations include three independent parameters (not two as in the traditional theory of volumetric viscous flow), they allow to describe the mechanical behaviour of deformed porous body more widely and flexibly.

Microstructural Evolution of Cu-10Cr Alloy during Spray Atomization Forming Route

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Abstract

In this study, hyper-eutectic Cu-10Cr alloy has been manufactured from spray forming route and hot extrusion, in order to achieve a fine scale microstructure. The extruded preform was subsequently cold-deformed to various strains where Cr particles were elongated into fine filament. In the spray forming process, velocity and temperature of atomized droplets have been predicted as function of droplet size and flight distance using a mathematical model based on fluid mechanics, heat transfer and phase transformation. The results gave an insight to establish quantitative guidelines for process optimization and to understand microstructural evolution during spray forming. The spray formed Cu-10Cr preform consisted of uniformly distributed, very smaller Cr particles in the Cu matrix, compared with the cast billet which had a coarse dendritic microstructure. During cold deformation, the small sized Cr particles in the spray-formed preform were readily elongated to form a fine filament, resulting in a high tensile strength up to 850 MPa at a relatively low deformation strain η of 4.5.