A MODEL FOR THE BIAXIAL POST-YIELD BEHAVIOR OF EXTRUDED POWDER ALUMINUM AT ELEVATED TEMPERATURE

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ABSTRACT

A model has been developed which describes the post-yield behavior of extruded powder aluminum tested biaxially in tension and torsion at elevated temperature. Plots of shear stress versus shear strain for the powder aluminum loaded in simple torsion show that the shear stress increases linearly to the yield point, then remains relatively constant in a pure plastic type of behavior. For the tension-torsion tests, there is an initial linear region up to the yield point followed by a fairly linear decrease in shear stress. A similar linear decrease in axial stress with increasing axial strain is observed in uniaxial tension tests. The model for post-yield behavior of extruded powder aluminum gives a quantified description of the macroscopic material behavior in terms of changes in the laminar powder aluminum structure.

INTRODUCTION

The structure of extruded powder aluminum is a consequence of the structure of aluminum powder particles and the extrusion process. Aluminum powder particles , each coated with a thin layer of aluminum oxide, are compacted to form a billet and then extruded into a rod. During the extrusion, the particles become greatly elongated, forming a laminar structure consisting of ligaments or laminae of aluminum separated by stringers of aluminum oxide. The presence of aluminum oxide is the major factor which causes the behavior of the extruded powder aluminum to differ so greatly from the behavior of the 1100 aluminum.

During extrusion, the material experiences tensile, compressive, and shear loadings [1,2]. The combination of tensile and shear deformation particularly effect the quality of the extruded rod. Therefore, a better understanding of the effects of tensile and shear deformation on powder aluminum should provide information that will aid in the design of improved extrusion dies.