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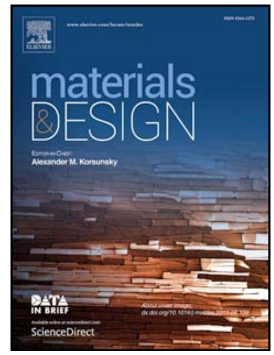

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L. Li, P. Xue, G. Luo

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A Numerical Study on Deformation Mode and Strength Enhancement of Metal Foam under Dynamic Loading

L. Li, P. Xue[1] and G. Luo
School of Aeronautics, Northwestern Polytechnical University, Xi'an, 710072, P.R. of China

Abstract

Deformation localization and strength enhancement are two typical features of dynamic compression response of metal foams. Under different impact velocities, metal foam exhibits different deformation modes in the dynamic compression process. Through in-depth study into the inherent mechanisms of metal foam deformation, two deformation modes are defined in this paper: the random mode and the band front mode. A new method based on 3D-Voronoi foam model is proposed to classify the deformation modes and determine the critical velocities of mode transition. Effects of strain rate of cell wall material and relative densities of metal foam on the deformation modes are investigated, and a map of deformation mechanisms is depicted. Under impact condition, it is found that the metal foam with low density exhibits low critical velocities. Moreover, when the cell-wall material is strain rate sensitive, both critical velocities decrease. Meanwhile, strength enhancement corresponding to each deformation mode is studied. The findings show that strength enhancement is deformation-mode dependent: in random mode the enhancement mainly comes from the strain rate sensitivity of cell wall material; while in band front mode, the enhancement mainly comes from the inertia enhancement.

Keywords: Metal foam, Deformation mode, Strength enhancement, 3D Voronoi model

Corresponding author:
P. Xue, School of Aeronautics, Northwestern Polytechnical University, Xi’an, China 710072
Email:p.xue@nwpu.edu.cn