

Propagation of One Dimensional Shock Wave in Functional Graded Aluminum Foam

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Abstract: As the manufacture technique of aluminum foam is developed, the graded aluminum foam with a gradual change in mechanical properties is available. More than one shock front can exist when the graded cellular material is subject to a one-dimensional impact. The dynamic response of graded cellular material foam is dominated by the distribution of mechanical properties and the shock effect, which are a pair of competitive factor. This paper analytically studied the dynamic response to one-dimensional impact of graded foam rod with a 'middle soft' gradient and a 'middle hard' gradient in density to find an optimal combination of these two dominant factors. Analytical solutions are derived based on the RPPL model. Two shock fronts are found to appear in the graded rod with 'middle hard' gradient, while three shock fronts with 'middle soft' gradient. The FE simulation is employed by using the voronoi structure and good agreement with the theoretical prediction is obtained.

Keywords: functional graded material; aluminum foam; shock wave effect;