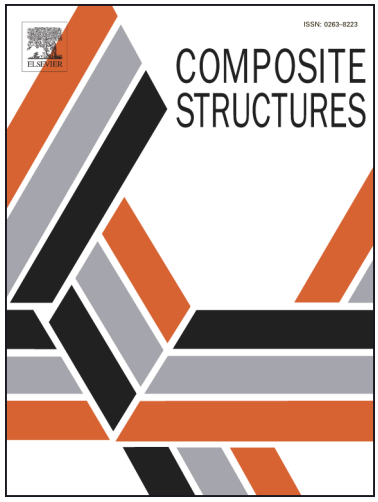

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Yukun An, Siyi Yang, Ertuan Zhao, Zongshen Wang

PII: S0263-8223(17)30775-4
DOI: http://dx.doi.org/10.1016/j.compstruct.2017.07.031
Reference: COST 8686

To appear in: *Composite Structures*

Received Date: 9 March 2017
Revised Date: 2 May 2017
Accepted Date: 12 July 2017

Please cite this article as: An, Y., Yang, S., Zhao, E., Wang, Z., Characterization of metal grid-structure reinforced aluminum foam under quasi-static bending loads, *Composite Structures* (2017), doi: http://dx.doi.org/10.1016/j.compstruct.2017.07.031

Characterization of metal grid-structure reinforced aluminum foam under quasi-static bending loads

Yukun An, Siyi Yang*, Ertuan Zhao, Zongshen Wang

School of Mechanical Engineering, Shandong University of Technology, Zibo 255000, P.R. China

*Corresponding author: yangsiyichina@yeah.net, Tel: +86 13070603662

Abstract

This paper investigates the bending property of metal grid-structure reinforced aluminum foam (MGS-AF) prepared by a melt foaming technique. For this purpose, quasi-static three-point bending tests of aluminum foam with and without metal grid-structures (MGSs) were performed. Experimental results indicate that the failure mode of MGS-AF was transformed from a single tensile failure to a combination of both tensile failure and compressive failure. Yield stress improved from 2.92-3.81 MPa for traditional aluminum foam to 6.58-8.41 MPa for MGS-AF. Also, a wide amplitude of stress plateau was detected after yield deformation. Additionally, the existence of MGS significantly improved the energy absorption capacity from 3.0 to 37.1-53.1 J and enhanced the specific energy absorption from 0.15-0.17 J/g to 1.34-1.50 J/g under the same deflection of 25 mm.

Keywords

Aluminum foam, Metal grid-structure, Three-point bending, Deformation mode, Energy absorption capacity

1. Introduction

Closed-cell aluminum foam has attracted increasing attention because of its exceptional properties, for instance, high specific strength and stiffness, thermal insulation capabilities [1], energy absorption abilities [2], and sound insulation [3]. Because of this unique combination of superior properties, aluminum foam is expected to be used as both a structural material and a functional material [4]. Up until now, aluminum foam has been used in the automobile, aerospace, and military industries as a cost-effective lightweight structure [5,6].

Over recent decades, much research has covered the significant number of approaches for fabricating aluminum foam. Among the various fabrication methods, the direct melt foaming method [*i.e.*, adding foaming agent (7) and gas injection (8,9)] and the powder metallurgical