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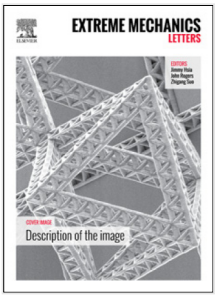

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Bin Han, Zhi-Jia Zhang, Qian-Cheng Zhang, Qi Zhang, Tian Jian Lu, Bing-Heng Lu

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Recent advances in hybrid lattice-cored sandwiches for enhanced multifunctional performance

Bin Han[1,2], Zhi-Jia Zhang[2,3], Qian-Cheng Zhang[2,3], Qi Zhang[1], Tian Jian Lu[2,3*], Bing-Heng Lu[1]

[1]School of Mechanical Engineering, Xi'an Jiaotong University, Xi'an 710049, PR China

[2]MOE Key Laboratory for Multifunctional Materials and Structures

Xi'an Jiaotong University, Xi'an 710049, China

[3]State Key Laboratory for Mechanical Structure Strength and Vibration

Xi'an Jiaotong University, Xi'an 710049, China

Abstract Ultralight sandwich structures with either two-dimensional (2D) prismatic or three-dimensional (3D) lattice truss cores, such as honeycombs, folded panels (corrugations) and pyramidal trusses, are known to possess attractive mechanical stiffness/strength and impact resistance. These properties can be significantly improved further by inserting different materials into the interstices of the lattices to construct hybrid lattice-cored sandwiches, as summarized in this mini-review. Three different types of hybrid lattice-core for sandwich constructions are discussed, including ceramic- or concrete-filled lattice cores for superior penetration resistance, metallic or polymeric foam-filled lattice cores for simultaneous enhancement in load-bearing and energy absorption, and metallic honeycomb-corrugation cores for simultaneous load-bearing, energy absorption and broadband low-frequency sound absorption. Corresponding enhancement mechanisms are explored.

Keywords Hybrid lattice-cored sandwich; Multifunctional properties; Strengthening; Energy absorption; Sound absorption

1. Introduction

As is well known, some desirable material properties are inaccessible for a single material, but could sometimes be achieved by making hybrids: combinations of two (or more) materials, or of material in space, in chosen configuration and scale [1-4]. The traditional method – developing new metal alloys, new polymer chemistries, and new compositions of glass and ceramics to access the desirable properties is usually an expensive and uncertain process. However, creating a hybrid is more economical and controllable. Particulate and fibrous composites, sandwich structures, foams, lattice structures, and segmented structures are successful examples of the hybrids [5-8].

Sandwich plates with periodic lattice cores such as pyramidal trusses [9,10], corrugated panels [11-14] and honeycombs [15-17] possess superior bending stiffness, strength and shock resistance relative to monolithic plates of equal mass, and present opportunities for additional functionality, such as active cooling and intelligent actuation. The lattice cores, usually with high porosity, possess enough interior interstices for exploring multifunctionalities, such as simultaneous load carrying and heat dissipation [18,19]. Recently, by inserting various materials into these interstices, it has been demonstrated that

*Corresponding author. Tel.: +86 29 82665600; Fax: +86 29 83234781.
E-mail address: tjlu@mail.xjtu.edu.cn (T.J. Lu).