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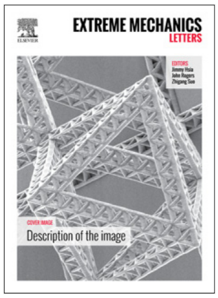

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Enhanced out-of-plane compressive strength and energy absorption of 3D printed square and hexagonal honeycombs with variable-thickness cell edges

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Abstract: Honeycomb structures have significant advantages in load-bearing and energy absorption. In recent years, some researches have been carried out on the in-plane mechanical properties of honeycombs with variable-thickness cell edges, but the out-of-plane compressive properties of this type of honeycombs have not been well studied. In this paper, the out-of-plane compressive properties of honeycombs with variable-thickness cell edges are investigated through experimental analysis. Here square and hexagonal honeycombs with variable-thickness cells are described with one geometric parameter. The experimental samples of these honeycombs were fabricated using 3D printing technology, and the quasi-static compression tests of these honeycombs were conducted. Experimental results illustrate that the honeycombs with variable-thickness cell edges show enhanced compressive mechanical properties compared to the conventional honeycombs. The highest increase rates of compressive strength of the presented square and hexagonal honeycombs are around 57% and 19%, respectively. In addition, the highest increase rate of specific energy absorption of these square honeycombs reaches up to 172%. The deformation and failure modes of square and hexagonal honeycombs with different geometric parameter values are also discussed and compared. Experimental results show that the square honeycombs with appropriate geometric parameter can achieve more desirable damage tolerance than the conventional square honeycombs.

Keywords: Honeycomb; Out-of-plane compression; Compressive strength; Energy absorption.

1. Introduction

In last decades, with the high specific stiffness, strength and high energy absorption ability [1-3], ultra-lightweight cellular materials [3] have been increasingly used as structure material in many fields such as aerospace [4], transportations [5], architecture [6] and biomedicine [7] .

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