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DYNAMIC IMPACT CHARACTERISTICS OF DEFECTIVE FUNCTIONALLY GRADED HONEYCOMBS

Abstract

With the characteristics of light weight, good shock absorption capability and ease of fabrication, the honeycomb structures have drawn a lot of attention. Due to the superior properties, the honeycomb systems have shown various potential applications such as aerospace, architecture, electrical techniques and biological engineering, etc. In this paper, the in-plane impact properties of functional graded honeycombs are studied with the consideration of defects. On the one hand, defects are introduced by missing some consecutive cell walls. The influences of the defect location on the dynamic crushing characteristics of the honeycombs are discussed. The dependences of the deformation modes and the energy absorption abilities on the defects location are discussed of the honeycomb structures. On the other hand, the functionally graded properties are introduced by changing the wall thicknesses, which leads to the varieties of density gradient. It should be noted that the positive density gradient means the thickness of the cell wall decreases along the impact direction and the negative density gradient denotes the thickness of the cell wall increases along that direction. Based on a given relative density, the dynamic deformation modes and energy absorption of the honeycombs with different density gradients are investigated. The results show that the energy absorption abilities for the honeycombs with the negative density gradient are much stronger than those with the positive ones. In general, both density gradient and defect location have significant influences on energy absorption ability. Furthermore, the influences of impact velocities are analyzed. The dynamic crushing behaviors are not sensitive to the impact directions at the lower velocities. With the increasing of the impact velocities, the energy absorption abilities of the honeycombs can be improved by adjusting the magnitude, especially the signs of the density gradients. At last, the coupling effects of the defects and functionally graded properties are discussed, which should be considered in the design and analysis of the mechanical characteristics of light-weight structures. This paper is helpful for the design and analysis of the mechanical characteristics of the honeycomb materials and structures.