

Analyses on the in-plane impact resistance of auxetic double arrowhead honeycombs

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Abstract

Double arrowhead honeycombs (DAHs) are a type of auxetic materials, i.e., showing negative Poisson's ratio (NPR) and are promising for energy absorption applications. Their in-plane impact responses are theoretically and numerically explored. Theoretical models for the collapse stress under quasi-static, low velocity and high velocity impacts are developed, based upon the corresponding microstructural deformation modes. Obtained results show that the collapse stress under quasi-static and low velocity impacts depends upon the two re-entrant angles responsible for NPR while it is insensitive to them under high velocity impact. The developed theoretical models are employed to analyze the energy absorption capacity of DAHs, showing the absorbed energy under high velocity impact approximately proportional to the second power of velocity. Extension of the high velocity impact model to functionally graded (FG) DAHs is also discussed. Good agreement between the theoretical and FE predictions on the impact responses of DAHs is obtained.

Keywords: Double arrowhead honeycombs; negative Poisson's ratio, impact response; energy absorption