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Mechanical Investigation of Phase-Transforming Cellular and Origami Materials

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ABSTRACT

Cellular materials, such as honeycombs and metallic foams, have attracted much attention due to their exceptional ability to absorb and diffuse mechanical energy. These materials have a wide range of applications, such as improving vehicle crash safety and helmet impact resistance. However, many of these materials are rendered unusable after one application. Phase-transforming cellular materials (PXCMs) utilize a reversible bistable mechanism to facilitate energy absorption from one-dimensional impacts and loads. These mechanisms have the added benefit over other cell structures of reusability. In this study, various PXCM designs are discussed and examined to determine their energy absorption capabilities.

Three different designs were tested: the common bending straw's ribbed mechanism, the Kresling pattern cylinder, and a sinusoidal beam mechanism. These designs underwent cyclic compression-tension load tests and their force-displacement curves were examined. These tests showed that all three designs exhibit significant energy absorption behaviors. Each design shows promise, warranting further detailed study of their full properties.

KEYWORDS

Phase transformation, cellular materials, energy absorption, origami