Exploring In-plane Elastic Properties and Energy Absorption of the Bio-inspired Glass Sponge Structure

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Abstract

The biological systems have evolved a diverse variety of robust skeletal architectures that can be used as lightweight structures to meet environmental requirements. However, the utilization of bio-inspired structures for energy absorption applications remains less common compared to conventional structures due to the novelty of the bionic approach in this field and limited fabrication capabilities. In this study, first we explore numerically and experimentally the in-plane elastic mechanical properties of lattice derived from Euplectella Aspergillum Glass Sponges (EA-sponge). The lattice structure is designed by approximating the architecture of EA-sponge using fused filament fabrication (FFF) process with thermoplastic Polylactic acid (PLA) filaments. The quasi-static compression test and finite element analysis (FEA) were conducted to study the energy absorption behavior of EA-sponge structures which involved open cells and close cells. The unit cell length of 10 mm, improved energy absorption by controlling buckling. Closed cells enhance stability, by increasing shear deformation mechanisms while open cells show increased waviness and unstable deformation mechanisms in EA-Sponge structure.

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