Twisting Cracks in Bouligand Structures

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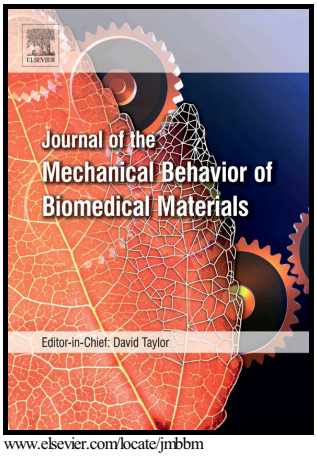

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Abstract

The Bouligand structure, which is found in many biological materials, is a hierarchical architecture that features uniaxial fiber layers assembled periodically into a helicoidal pattern. Many studies have highlighted the high damage-resistant performance of natural and biomimetic Bouligand structures. One particular species that utilizes the Bouligand structure to achieve outstanding mechanical performance is the smashing Mantis Shrimp, *Odontodactylus Scyllarus* (or stomatopod). The mantis shrimp generates high speed, high acceleration blows using its raptorial appendage to defeat highly armored preys. The load-bearing part of this appendage, the dactyl club, contains an interior region [16] that consists of a Bouligand structure. This region is capable of developing a significant amount of nested twisting microcracks without exhibiting catastrophic failure. The development and propagation of these microcracks are a source of energy dissipation and stress relaxation that ultimately contributes to the remarkable

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