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PROCEEDINGS

Additively Manufactured Dual-Faced Structured Fabric for Shape-Adaptive Protection

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ABSTRACT

Fabric-based materials have demonstrated promise for high-performance wearable applications but are currently restricted by their deficient mechanical properties. Here, we leverage the design freedom offered by additive manufacturing and a novel interlocking pattern to for the first time fabricate a dual-faced chain mail structure consisting of three-dimensional re-entrant unit cells. The flexible structured fabric demonstrates high specific energy absorption and specific strength of up to 1530 J/kg and 5900 N·m/kg, respectively, together with an excellent recovery ratio of ~80%, thereby overcoming the strength–recoverability trade-off. The designed dual-faced structured fabric compares favorably against a wide range of materials proposed for wearable applications, attributed to the synergetic strengthening of the energy-absorbing re-entrant unit cells and their unique topological interlocking. This work advocates the combined design of energy-absorbing unit cells and their interlocking to extend the application prospects of fabric-based materials to shape-adaptive protection.

KEYWORDS

Dual-faced structured fabric; additive manufacturing; energy absorption; deformation recovery; shape-adaptive protection

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