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PROCEEDINGS

3D Printing of Triple Periodic Minimal Surface Structures for Customized Personal Wearable Devices

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ABSTRACT

3D printing of metamaterials has garnered significant attention in recent years, as metamaterials, especially the triple periodic minimal surface (TPMS) structures, are engineered to exhibit extraordinary properties. However, challenges such as limited structural designs and lack of real-world applications have restrained the development of 3D printed metamaterials. Herein, a series of TPMS structures were designed and printed via selective laser sintering, and their mechanical energy absorption capabilities under the quasi-static compression condition were compared. Novel TPMS structures were then designed by blending the investigated TPMS structures, and their compressive properties and deformation mechanism were explored. It was concluded that structures experiencing the bending-dominated deformation exhibited lower mechanical strength while structures that undergo the buckling-dominated deformation exhibited higher mechanical energy absorption. By blending the TPMS structures, the mechanical properties could be tuned according to the requirements of specific applications. This paper also presents a demonstration of a shoe insole designed for diabetes patients, illustrating the potential application of these customized personal wearable devices.

KEYWORDS

Metamaterials; triple periodic minimal surface structures; selective laser sintering; compressive properties

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