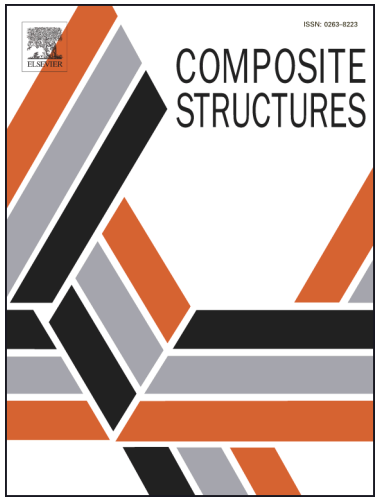

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Hoberman-Sphere-Inspired Lattice Metamaterials with Tunable Negative Thermal Expansion

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Abstract:

Materials with engineered thermal expansion coefficients, capable of avoiding failure or irreversible destruction of structures and devices, are important for aerospace, civil, biomedical, optics, and semiconductor applications. In natural materials, thermal expansion usually cannot be adjusted easily and a negative thermal expansion coefficient is still uncommon. Here we propose a novel architected lattice bi-material system, inspired by the Hoberman sphere, showing a wide range of tunable thermal expansion coefficient from negative to positive, -1.04×10^{-3} $^{\circ}C^{-1}$ to 1.0×10^{-5} $^{\circ}C^{-1}$. Numerical simulations and analytical formulations are implemented to quantify the evolution of the thermal expansion coefficients and reveal the underlying mechanisms responsible for this unusual behavior. We show that the thermal expansion coefficient of the proposed