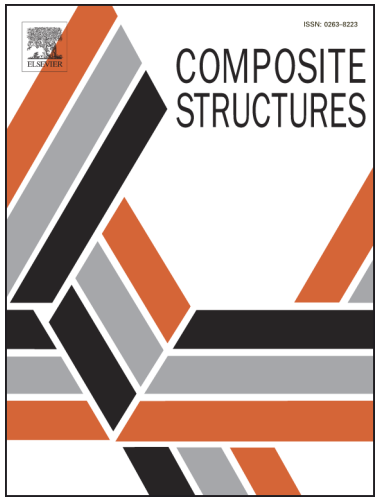

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Double-layer Sandwich Annulus with Ultra-low Thermal Expansion

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Abstract:

Zero or negative coefficient of thermal expansion (CTE) material is a rare abnormal phenomenon in nature but preferred in such engineering applications as optical components and precision instruments, etc. Most of them in nature are brittle and can operate only in a narrow temperature range. Artificial metamaterials offer a new route towards materials with tunable CTEs and excellent mechanical properties. However, these materials engineered by periodic architectures generally lack homogeneity, and thus the integrations into applications are limited. Here, a double-layer sandwich annulus integrating fork-like lattice cells and continuous interfaces is constructed. As the basis, the tunability of effective CTEs is theoretically modeled to reveal its dependence on the diameters of rings, the lengths of beams with higher CTE in fork-like cells and constituent materials' CTEs. The thermal properties are also characterized experimentally on a bi-material metallic sample targeting for zero CTE purposely. The measured results demonstrate the ultra-low

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