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THE TOPOLOGICAL DESIGN OF THERMOELASTIC MATERIAL USING A LEVEL SET METHOD

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In this paper, a level set-based parameterization method is proposed to design the three-phase composite material with specified thermal expansion coefficient. The composites are comprised by periodic base cells, and made of a three-phase material (two different material phases and a void phase). The numerical homogenization method is applied to compute effective elastic and thermal expansion properties of the composite based on a finite-element discretization of the base cell. The optimal distribution of material phases within the periodical unit cell is found using level set-based parameterization method under certain constraints, such as elastic symmetry, volume fractions of the constituent phases, and lower limit of bulk modulus. A MATLAB program is developed to conduct the composite material design and the results demonstrate that materials with zero and negative effective thermal expansion coefficients can be achieved by three-phase materials.