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MINIMIZATION OF THE EFFECTIVE THERMAL EXPANSION COEFFICIENT OF COMPOSITE MATERIAL USING A MULTI-SCALE TOPOLOGY OPTIMIZATION METHOD

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Abstract: This article proposes a methodology to design composite materials, considering two distinct materials phases and one void phase simultaneously, in order to minimize the thermal expansion coefficients. The design of composite material is treated as a topology optimization problem with a multi-material and multi-scale approach. The Bi-directional Evolutionary Structural Optimization method (BESO) is used to solve the optimization problem and the homogenization method is applied to obtain the equivalent properties for the designed material. In order to show the suitability of the implemented methodology, it is presented some examples for the minimization of the homogenized thermal expansion coefficients considering two-dimensional state of stress. A setting using two material phases, and void was performed resulting in a set of orthotropic materials with thermal expansion less than 10% of the case composing the domain with any of the material phases used.