

CALCULATION OF EFFECTIVE PROPERTIES FOR FIBER-REINFORCED PIEZOELECTRIC COMPOSITES

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The theoretical and/or experimental investigation of the global properties of composite materials occupies a determining place in obtaining new materials with better specific characteristics, for a given application. The efficiency of the experimental route necessarily depends on a theoretical guide or mathematical model. During the last four decades much research has been directed to the development of homogenization methods capable of theoretically predicting such effective properties. Composite materials with a periodic structure appear in important technological applications in various areas of civil and mechanical engineering, in the sports industry, in electronics, among others. The determination of its effective properties when the physical and geometric properties of its components are known represents a useful tool for an adequate design and optimization. The method of asymptotic homogenization (AHM), which is based on a double-scale asymptotic expansion, is a rigorous mathematical technique for calculating the effective coefficients of such heterogeneous means. From a mathematical point of view, this method guarantees that the solution of the original problem with a periodic microstructure converges to the solution of the homogenized problem when the period of the microstructure tends towards zero. In this way, the study of the initial problem on a heterogeneous medium is transferred to that of an equivalent problem, on a homogeneous medium, which requires the solution of the so-called local problems on the periodic cell. The present investigation is about the effectiveness of the use of the finite element method to calculate the effective properties in piezoelectric materials. Two cases were analyzed in the first one was considered in a cubic cell (epoxy) embedded with a fiber of piezoelectric material (PZT-5), in the second case a hexagonal cell with the same fiber,, for both cases the results obtained were analyzed and discussed.

Keywords: The method of asymptotic homogenization, piezoelectric, effective properties

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