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ABSTRACT.

A comprehensive asymptotic homogenization model for the analysis of composite and reinforced magnetoelectric plates is developed. The model culminates in a set of unit cell problems via which the relevant expressions for the effective coefficients are derived. The micromechanical and geometrical platform pertinent to the desired model is set up in this paper which also obtains the effective elastic, piezoelectric and piezomagnetic coefficients; the remaining properties, including product properties, are calculated in another work. Examples of structures that can be examined include diagonally- and triangularly-reinforced plates, hexagonal honeycomb sandwich plates and others. The developed model can be used to customize the effective properties of a reinforced plate to the requirements of a particular engineering application by changing some geometric, structural or material parameter of interest. It is shown that in the limiting case of a thin composite plate of uniform thickness whereby electrical conductivity is ignored and all pertinent quantities are time-averaged the presented model converges to the familiar classical plate model. Overall, this paper represents an important addition to the existing literature in terms of the complex geometries that can be designed and analyzed and at the same time constitutes an important refinement over previously published work.

Keywords: magnetoelectric reinforced plate; asymptotic homogenization; effective properties; hexagonal honeycomb sandwich; diagonally-reinforced plate; triangularly-reinforced plate

1. Introduction

The micromechanical behavior of periodic composites and smart composites is characterized by the existence of two different scales; the microscopic or "fast" scale is a function of the geometric and structural make-up of the composite (type, geometric characteristics and spatial distribution of the inclusions, nature of the matrix material, etc.) whereas the macroscopic or "slow" scale is a manifestation of the global formulation of the problem (boundary conditions, external loads etc.). The presence of these two different and superimposed scales renders an analytical solution practically impossible except in the case of the simplest geometries. Even a numerical

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