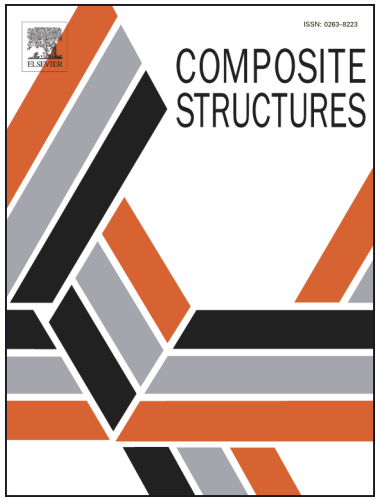

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Elastic dependence of particle-reinforced composites on anisotropic particle geometries and reinforced/weak interphase microstructures at nano- and micro-scales

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Abstract: This contribution sheds light on the coupled effects of anisotropic particle geometries (i.e., shape and size) and reinforced/weak interphase characteristics (i.e., volume fraction, thickness, moduli and Poisson ratio) on the elastic properties of particle-reinforced composites (PRCs) at nano- and micro-scales. A powerful micromechanics approach that incorporates interphase microstructures into the average-field theory is used to predict the effective elastic modulus, Poisson ratio, shear modulus and bulk modulus of three-phase PRCs including spheroidal nano-/micro-particles, reinforced/weak interphase and matrix. Comparison with measurements indicates this optimized model is a reliable means to evaluate the elastic properties of three-phase PRCs at nano- and micro-scales. Plus, the results show that the elastic response of PRCs strongly depends on the coupled effects of the aspect ratio and geometrical size factor of spheroidal nano-/micro-particles and the volume fraction of reinforced/weak interphase, suggesting that the properties of such materials can be tailored via proper composite engineering and design.

Keywords: Particle-reinforcement; Anisotropy; Elasticity; Interface/interphase; Micro-mechanics

1. Introduction

It is well-known that interphase interacted by anisotropic nano-/micro-sized particles broadly exists in particle-reinforced composites (PRCs) such as polymer-matrix, ceramic-matrix and cement-matrix

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