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Nano-structured interpenetrating composites with enhanced Young's modulus and desired Poisson's ratio

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Abstract

This paper has demonstrated that interpenetrating composites could be designed to not only have an significantly enhanced Young's modulus, but also have a Poisson's ratio at a desired value (e.g. positive, or negative, or zero). It is found that when the effect of the Poisson's ratio is absent, the Young's modulus of interpenetrating composites is closer to the Hashin and Shtrikman's upper limit than to their lower limit, and much larger than the simulation and experimentally measured results of the conventional isotropic particle or fibre composites. It is also illustrated that at the nanoscale, the interphase can either strengthen or weaken the stiffness, and the elastic properties of interpenetrating composites are size-dependent.

Keywords: A. Structural Composites; C. Elastic Properties; C. Modelling; B. Interphase.

1. Introduction

In nature, many living materials have an interpenetrating-phase structure, examples include fruits and vegetables which have a fibrous network embedded in a soft tissue. In an interpenetrating composite, if one constituent phase is damaged or removed, the remaining phase is a completely interconnected network and still has a good capacity to enable the mechanical function. Some people have produced interpenetrating composites and

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