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Comparison of lattice structured interpenetrating composites with enhanced Young's modulus

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ABSTRAT

The mechanical properties of interpenetrating phase composites (IPCs) with interconnected network in reinforced phase are compared to its conventional counterparts. It has been found that the Young's Moduli of interpenetrating composite can substantially exceed the Voigt limit, which had long been regarded as an unexceedable upper stiffness limit of isotropic composite materials. This paper is a numerical approach to explore the elastic performance of different IPCs, and how different parameters of lattice micro IPCs structures influence the normalized elastic properties of the composites. Three different periodical microstructures are modelled. The open-celled lattice space is filled by the matrix material. Influences of the volume fraction, Young's modulus and Poisson's Ratio of the component materials are also considered. We conclude that Young's modulus of all the three different structures can exceed the Voigt limit under certain combinations the mechanical properties of the two phases. Among these IPCs structures, the tetrahedron modelled performs the best when the Poison's Ratio of the reinforced phase is negative. We also compared our results to those of the conventional particle and fibre reinforced composites. The Young's moduli of our structures are well in line with the experimental results of the composites with similar structure, and much larger than those of the conventional isotropic particle or fibre composites.

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