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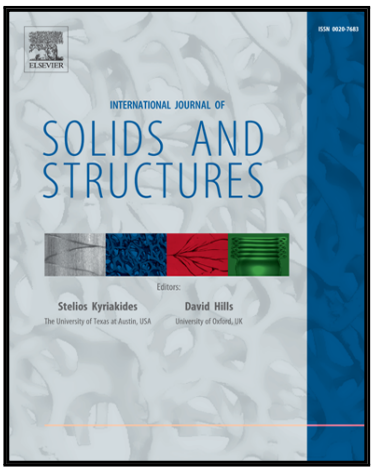

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Micromechanical modeling of effective elastic properties of open-cell foam

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Abstract

The aim of this study is to investigate the influences of morphological parameters on the effective elastic properties of open-cell foam. We develop an innovative approach combined with Voronoi diagram for the generation of representative cellular materials. The generated structures are able to represent the details of the microstructure and cover a large range of open-cell foams commonly used in industrial applications. A micromechanical modeling based on Hill's lemma approach is implemented for predicting the effective elastic properties. The influences of the morphological parameters on the elastic effective properties are analysed. Based on this assessment, new generic analytical laws are deduced for Kelvin open-cell foam structures by considering their morphological parameters.

Keywords: open-cell foam, Voronoi, morphology, computational homogenization, mechanical properties, new generic laws

1. Introduction

Cellular foams are important materials for a wide range of applications due to the excellent combination of mechanical and thermal properties. For example, high porosity polymer foams, such as polystyrene foams and polyurethane foams, can be used as thermal insulating materials (Coquard and Baillis, 2006; Placido et al., 2005; Kaemmerlen et al., 2010; Collishaw and Evans, 1994). Ceramic and metallic foams are often used in various high temperature applications (Gauthier et al., 2007; Fend et al., 2004; Lu and Chen, 1999; Mey-Cloutier et al., 2016). Several metallic foams, primarily

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