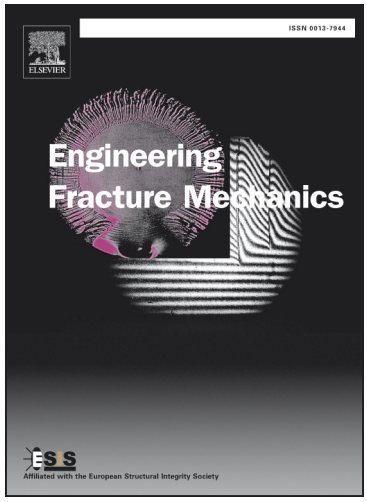

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Determination of stress intensity factors of 3D curved non-planar cracks in FGMs subjected to thermal loading

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Abstract

A finite element analysis is presented about 3D curved non-planar cracks in functionally graded materials (FGMs) subjected to steady state temperature gradients. The interaction energy integral is employed in conjunction with a computational strategy that does not require a priori information about crack front and crack surface curvatures. The influence of graded thermal and mechanical properties on mixed mode stress intensity factors (SIFs) is explored in detail. Results highlighted the robustness of the proposed computational framework, which therefore can be effectively deployed in the analysis of thermal fracture in FGMs containing curved non-planar cracks.

Keywords: FGMs, non-planar cracks, thermal SIFs, interaction integral, micromechanics models

1. Introduction

Functionally Graded Materials (FGMs) are nonhomogenous materials whose microstructure and composition are engineered so that to achieve a continuos spatial variation of mechanical and physical properties. A significant body of literature has explored multiple aspects of FGMs, including manufacturing and analysis, as recently reviewed in [1]. Several fabrication techniques have been developed (e.g. spark plasma sintering, plasma spray technique and physical vapor deposition) and analytical and numerical efforts have been carried out in order to sustain experimental investigations and the design of FGMs systems [2, 3, 4, 5, 6, 7, 8]. One of the most important design aspect that has been emphasized in earlier works relates to the integrity of cracked components made up of FGMs subjected to thermo-mechanical loading. The use of graded materials for thermal protection sys-

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