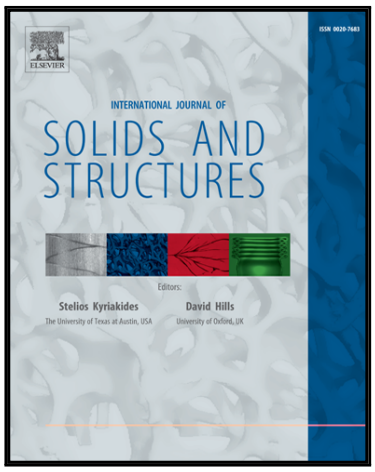

A contact zone approach for an arc crack at the interface between two electrostrictive materials

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A contact zone approach for an arc crack at the interface between two electrostrictive materials

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Abstract

Solution of the contact problem for an electrostrictive plane with a circular electrostrictive inclusion having an arc crack at the materials interface under the influence of general mechanical and electrical loadings at infinity is obtained. It is assumed that both materials are isotropic and linear elastic and the crack faces are smooth and permeable to an electric field. The problem is considered as an uncoupled problem of electroelasticity. Solution of electrostatics problem is obtained by complex potentials method. The boundary problem of electroelasticity for four complex potentials which are analogous to Kolosov–Muskhelishvili potentials is reduced to the singular integral equation of the second kind. This equation is solved under the condition of displacements uniqueness and vanishing of the crack opening within the contact zone. The solution has been carried out approximately by developed new algorithm which takes into account both a possible complex singularity at the "open" crack tips and a contact zone of unknown length. Crack opening, normal and shear stresses at the materials interface and the stress intensity factors at the crack tips are found.

Keywords

Electrostriction; arc crack; crack faces contact; singular integral equation; stress intensity factor.

1. Introduction

Electrostrictive materials, in particular ferroelectric relaxors, become widespread in modern technologies because the electrostrictive effect in these relaxors is close to the piezoelectric one. As described in [16], cracks may appear in electrostrictive materials under the action of large electrical and mechanical stresses. Therefore, it is important to study the behavior of cracked electrostrictive materials under the action of electrical and mechanical loads. Also, as shown in many papers, e.g. in [4] and [5], the faces of an arc crack may contact with each other along the considerable part of