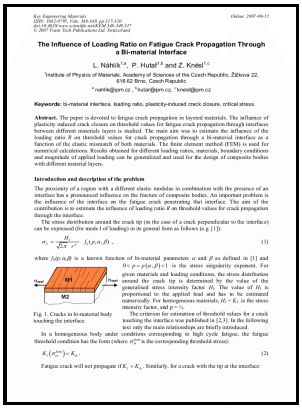
Influence of fatigue crack wake length and state of stress and on crack closure

National Aeronautics and Space Administration, Lewis Research Center - Fatigue crack closure



The Influence of Loading Ratio on Fatigue Crack Propagation Through a Bi-material Interface

L. Náhlík[1,a], P. Hutař[1,b] and Z. Knésl[1,c]

[1]Institute of Physics of Materials, Academy of Sciences of the Czech Republic, Žižkova 22, 616 62 Brno, Czech Republic

[a] nahlik@ipm.cz, [b]hutar@ipm.cz, [c]knesl@ipm.cz

Keywords: bi-material interface, loading ratio, plasticity-induced crack closure, critical stress.

Abstract. The paper is devoted to fatigue crack propagation in layered materials. The influence of plasticity induced crack closure on threshold values for fatigue crack propagation through interfaces between different materials layers is studied. The main aim was to estimate the influence of the loading ratio R on the threshold values for crack propagation through the interface. The study is a function of the elastic mismatch of both materials. The finite element method (FEM) is used for numerical calculations. Results obtained for different loading ratios, materials, boundary conditions and magnitude of applied loading can be generalized and used for the design of composite bodies with different material layers.

Introduction and description of the problem

The proximity of a region with a different elastic modulus in combination with the presence of an interface has a pronounced influence on the fracture of composite bodies. An important problem is the influence of the interface on the fatigue crack penetrating that interface. The aim of the contribution is to estimate the influence of loading ratio R on threshold values for crack propagation through the interface.

The stress distribution around the crack tip (in the case of a crack perpendicular to the interface) can be expressed (for mode I of loading) in its general form as follows (e.g. [1]):

$$\sigma_y = \frac{H}{\sqrt{2\pi}} \cdot \frac{1}{r^{\beta}} \cdot f_{ij}(\alpha,\beta) \,, \qquad (1)$$

where $f_{ij}(\alpha,\beta)$ is a known function of bi-material parameters α and β as defined in [1] and $0 < \beta = p(\alpha,\beta) < 1$ is the stress singularity exponent. For given materials and loading conditions, the stress distribution around the crack tip is determined by the value of the generalised stress intensity factor H. The value of H is proportional to the applied load and has to be estimated numerically. For homogeneous materials, $H = K_I$ is the stress intensity factor, and $p = \frac{1}{2}$.

Fig. 1. Cracks in bi-material body touching the interface.

The criterion for estimation of threshold values for a crack touching the interface was published in [2,3]. In the following text only the main relationships are briefly introduced.

In a homogeneous body under conditions corresponding to high cycle fatigue, the fatigue threshold condition has the form (where $\sigma_c^{(a)}$ is the corresponding threshold stress):

$$K_I\left(\sigma_c^{(a)}\right) = K_{Ic} \qquad (2)$$

Fatigue crack will not propagate if $K_I < K_{Ic}$. Similarly, for a crack with the tip at the interface:

Description: -

-

Tensile properties.
Stress intensity factors.
Fatigue (materials)
Crack closure.
Metals -- Fatigue.Influence of fatigue crack wake length and state of stress and on crack closure

-

NASA technical memorandum -- 87292.Influence of fatigue crack wake length and state of stress and on crack closure
Notes: Microfiche. [Washington, D.C. : National Aeronautics and Space Administration], 1986. 1 microfiche.
This edition was published in 1986

Tags: #Fatigue #(material)

Crack growth equation

From the analysis of the standard sample shown in Fig. With continued cycling, the minimum strain in the cycle increases at a higher rate, indicating an increasing influence of the creep time-dependent component to the damage accumulation.

Crack growth equation

Of course, it is impossible to disregard the possibility that smaller pores, below the resolution limit of the CT, did exist close to the initiating pore and contribute to the stress concentration.

crack closure model and its application to vibrothermography by Bryan Schiefelbein

The results are shown in Fig. The effect can be significant when test specimens are removed from materials that embody residual stress fields; for example weldments or complex shape forged, extruded, cast or machined thick sections, where full stress relief is not possible, or worked parts having complex shape forged, extruded, cast or machined thick sections where full stress relief is not possible or worked parts having intentionally-induced residual stresses.

Fatigue Crack Growth Fundamentals in Shape Memory Alloys

The effective threshold stress intensity range is 8. The effective stress intensity range upon regression of the entire displacement field is also included in Fig. They provided initial expressions for G I and G II valid only for pure mode, homogeneous problems.

CiteSeerX — PROPAGATION PATH AND FATIGUE LIFE PREDICTIONS OF BRANCHED CRACKS UNDER PLANE STRAIN CONDITIONS

It is noted that the Zone 2 provides negligible contribution while Zones 1 and 3 provide a smaller contribution compared to Zone 4.

Fatigue Crack Growth

This slip is not a change within the material, but rather a propagation of within the material. The pore size distribution in the four specimens is summarised in Fig.

Influence of Fatigue Crack Wake Length and State of Stress on Crack Closure

Xiong F, Liu Y 2007 Effect of stress-induced martensitic transformation on the crack tip stress-intensity factor in Ni-Mn-Ga shape memory alloy.

Influence of Fatigue Crack Wake Length and State of Stress on Crack Closure

Adhesion hysteresis only satisfies the experimental observation that heating vanishes for high compressive loading if surface roughness and the instability of surface adhesion is considered.

Related Books

- Underlying principles of modern legislation
- Portuguese revolution and the Armed Forces Movement
- Future of natural fibres - papers presented at a Shirley Institute Conference on 29-30 November 1977
- Beyond conception - the new politics of reproduction
- Philips foundation atlas.