CRACK TRAPPING IN THE INTERFACE BETWEEN MATRIX AND INCLUSION

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The interaction between an inhomogeneity and a crack propagating near the circular inhomogeneity is studied under the assumptions of linear elastic fracture mechanics (LEFM) (we assume elastic behaviour of the matrix and the inhomogeneity as well). Three cases (see fig. 1) are considered: a crack located in front of the inhomogeneity (a), a crack situated arbitrarily near the inhomogeneity (b), and a special case when the crack tip lies at the interface between the matrix and the inhomogeneity (c). The main purpose of this paper is to find the most often configurations in materials with inhomogeneities.

Key words: *composite materials, fracture mechanics, bi-material interface*

1. Introduction

In two-phases composites, when there a crack occurs near an inhomogeneity, the shape of the inhomogeneity and the difference in the elastic properties of the inhomogeneity and the matrix material will cause the near-tip stress intensity factor to be greater or less than that in a homogeneous material (situation in Fig. 1(a)).

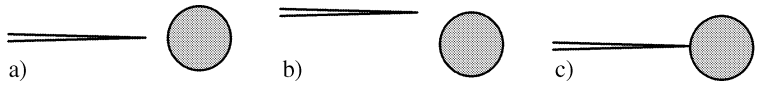

Fig.1: The studied cases: (a) a crack approaching to the inhomogeneity, (b) crack propagating near the inhomogeneity, (c) crack with its tip at the interface between the inhomogeneity and the matrix

When the crack is propagating near the inhomogeneity, e.g. under the assumptions of high cycle fatigue, the direction of its propagation will change because of the different elastic properties of the inhomogeneity and the matrix [5] (fig. 1(b)). The stress field in front of the crack tip can be described, as in the case before, by the stress intensity factor K [MPa.m$^{1/2}$]. For the crack to propagate in cases (a) and (b), if we consider predominantly normal mode of loading, it has to be:

$$K_{\mathrm{I}} \geq K_{\mathrm{IC}} \ , \tag{1}$$

where K_{IC} is the critical value of stress intensity factor of the matrix.

Fig. 1(c) shows a special case where the crack tip is situated at the bi-material interface. In this case, it is not possible to use the criteria of the classical fracture mechanics because the stress intensity exponent p differs from 1/2. It lies in the interval $\langle 0; 1\rangle$. The stress field in front of the crack tip is described by the generalized stress intensity factor H [MPa.m^p]

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