Nonlinear elasticity in the coupled criterion : Influence on crack initiation and propagation

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Abstract

This work focuses on the influence of considering the nonlinear elasticity of the material to study crack initiation and propagation using the coupled criterion. Experimental observations of i) unstable crack initiation at a circular hole or at a V-notch and ii) stable crack propagation under opening mode combined with different T-stress levels show some limitations of linear elastic fracture mechanics in i) predicting crack initiation and ii) characterizing the material critical energy release rate or critical stress intensity factor. The application of the coupled criterion (1) considering the nonlinear elastic behaviour of the material is presented. First, we highlight how the consideration of the nonlinear elastic material behaviour improves the inverse identification of the material fracture properties based on a set of two crack initiation experiments, namely a plate with holes under tensile loading and TDCB specimens. We then discuss how the dependence of the apparent critical stress intensity factor on the T-stress level measured by Digital Image Correlation can be explained by the nonlinear material behaviour. (1) Leguillon, D. : Strength or toughness ? a criterion for crack onset at a notch. European Journal of Mechanics - A/Solids 21(1), 61–72 (2002). doi:10.1016/S0997-7538(01)01184-6

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