Numerical investigations on the three-dimensional I/II mixed-mode elasto-plastic fracture for through-thickness cracked bodies

WANG Fang-li[1],TONG Ming-bo[1],BAI Shu-wei[1],JIANG Nan[1], FAN Jun-ling [2],
[1]*Nanjing University of Aeronautics & Astronautics, China;*
[2]*AVIC Aircraft Strength Research Institute, China*

Based on three-dimensional (3-d) I/II mixed-mode fracture experiments on an LC4CS aluminium alloy, 3-d I/II mixed-mode elasto-plastic finite element models were established using the commercial software package ANSYS. The coupled effects of the varied degrees of mode-mixing Φ and thickness B on the stress field around the crack tip were analysed, and then the coupled effects of mode-mixing Φ, thickness B, and relative length a/W on the load-crack opening displacement curve were investigated. The results showed that the angle of the maximum tangential stress and the minimum out-of-plane stress constraint factor (Tz) appeared at the same angle with each increment of Φ,and the effects of thickness became weaker with changes to the direction angle of σθθmax and Tzmin with each increment of thickness. The load-crack opening displacement curve was affected by loading angle, relative length a/W, and thickness: the thickness effect was stronger when mode I loading predominated. The load-crack growth length curve can be plotted with reference to the experimental load-crack opening displacement curve, which can be used to predict initiation load in static fracture experiments.

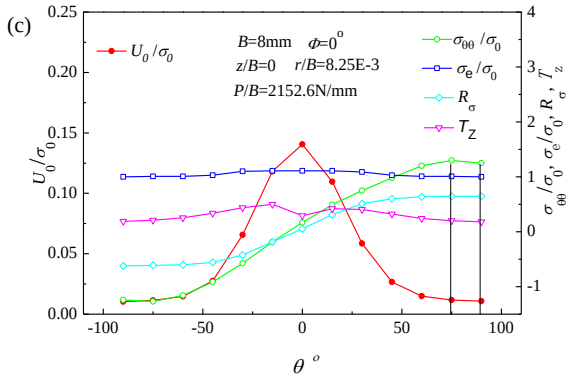

Figure 1. Angular distributions of parameters near crack tips for 8 mm thickness under various loading angle conditions

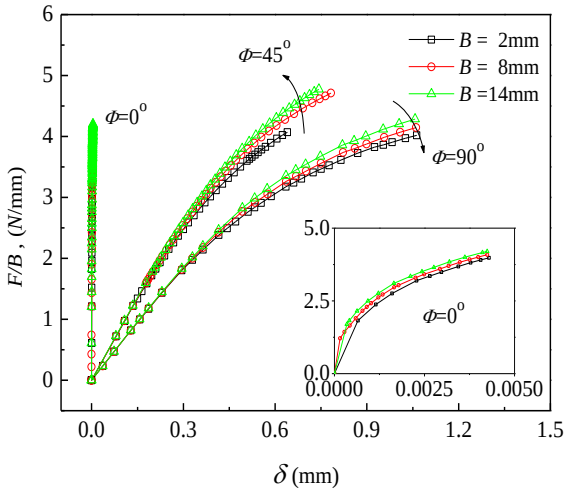

Figure 2. Load-crack opening displacement curves for different thicknesses under various loading conditions

Keywords: 2024HDT aluminum alloy crack morphology stress intensity factor fatigue