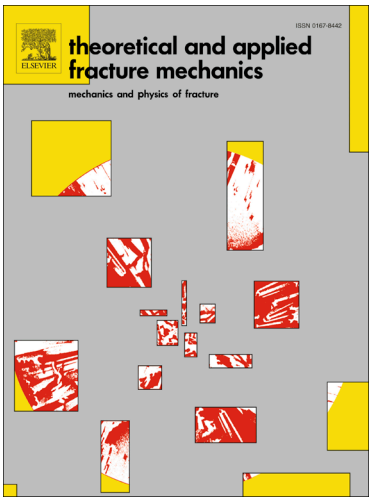

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Experimental Observation and Energy Based Analytical Investigation of Matrix Cracking Distribution Pattern in Angle-Ply Laminates

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Abstract

An energy based criteria is developed to predict the leading distribution pattern of matrix cracks in the damage mode competition in angle-ply laminates of type $\left[\theta_m^{(1)}/\theta_n^{(2)}\right]_s$ subject to uniaxial tensile loading. For the first time in the literature, all plausible matrix crack distribution patterns, namely mid-ply or staggered/symmetric outer-ply cracking are considered and energy release rate for initiation of each case is derived. Different geometrical effects such as ply orientation, thickness ratios and scale effects are investigated on the initiation distribution pattern of matrix cracks. The results show that distribution pattern of matrix cracks is directly affected by geometrical factors. Test specimens with different geometrical characteristics are prepared from unidirectional carbon-epoxy and an experimental test setup is prepared to capture the distribution pattern of matrix cracks during tensile loading. The predicted matrix crack distribution patterns of all specimens are verified by experimental observations.

Keywords: Matrix cracking distribution pattern, Energy release rate, Crack pattern competition, Angle-ply laminate

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