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A damage mechanics based failure criterion for fiber reinforced polymers

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Abstract

In this paper an energy-based failure envelope for unidirectional fiber reinforced polymers (FRP) has been developed. It is based on the stress and the damage energy release rate (DERR) components, which makes it suitable for being used as a damage surface in continuum damage mechanics (CDM), when a thermodynamically consistent evolution rule is intended to be used. The proposed failure surface is an interactive quadratic function of the DERR components accompanying with linear stress components in the form of an invariant. The mathematical formulation of the criterion is originated from the fully interactive Tsai-Wu criterion. The failure locus of the two criteria were compared with each other for several unidirectional FRP composites under several combined stress states. The two criteria were found to be in a reasonably good agreement for investigated composites with E-glass and carbon fibers, especially where the experimental data were available.

Keywords

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