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Characterization and Numerical Simulation of Delamination Propagation Behavior in Carbon Fiber Reinforced Composite Laminates

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ABSTRACT

Advanced carbon fiber reinforced composite materials are increasingly being used in aerospace and other fields. Composite laminate structure is one of the commonly used configurations, but due to weak interlayer performance, interlayer delamination is prone to occur [1]. The occurrence and growth of delamination will seriously affect the overall integrity and safety of composite structures, making it a focus of attention in the design of laminated structures. Accurately characterizing the delamination mechanical properties of composite laminates and simulating delamination propagation behavior is the basis for damage tolerance design and analysis of composite structures with delamination damage [2]. Composite materials usually use interlayer fracture toughness to characterize the ability of composite laminates to resist delamination failure. Currently, international testing standards have been established for the delamination performance of unidirectional composite laminates [3]. In terms of numerical simulation, virtual crack closure technique, cohesive zone model, and extended finite element method have been developed. However, composite multi-directional laminates are widely used in engineering structures. During the delamination process of multi-directional laminates, the fracture process zone is large due to fiber bridging, and the failure behavior and mechanism are much more complex than unidirectional laminates [4,5]. There are many problems and challenges in extending the corresponding characterization methods and numerical simulation methods to multi-directional laminates. This study mainly introduces the research progress of our research group in recent years on the characterization and numerical simulation of delamination propagation behavior in carbon fiber reinforced composite laminates.

KEYWORDS

Polymer-matrix composite; laminate; delamination; fracture toughness; finite element analysis

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