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PROGRESSIVE DAMAGE ANALYSIS OF A 4D IN-PLANE BRAIDED C/C COMPOSITES SUBJECTED TO UNIDIRECTIONAL TENSION

Abstract

Abstract: A representative Volume Cell is established to investigate the progressive damage and failure mechanism of a 4D in-plane C/C composites with interfacial debonding. The three dimensional Hashin criterion is adopted to characterize the different damage modes of the fiber bundle, then the Murakam damage theory is utilized to indicate the anisotropic damage ,by which the elastic modulus is degraded. The maximum principle stress criterion is chosen as the matrix damage initiation. In order to study the interface effect, Cohsive Zone Model is applied for the fiber/matrix interface. For modeling convenience, zero thickness cohesive elements are inserted between fiber bundles and matrix using Fortran program codes. The damage evolution of the constituents is based on the fracture energy, local strain and element characteristic length. With periodic boundary conditions imposed on, the meso-scopic damage initiation, development and failure of the material are accomplished numerically by Abaqus UMAT codes, and then the failure mechanism is analyzed. The effects of fiber, matrix strength and interface on the tensile properties are investigated. The numerical results basically agree with experimental results. The numerical results indicate that fiber longitudinal tensile and shear failure is the major mode for the material failure, and the tensile strength of the material increases linearly with the fiber strength, and increases slightly with matrix strength. The interface has an obvious influence on the tensile property.
Keywords: 4D in-plane C/C composites; interfacial debond; progressive damage; Representative volume cell; strength prediction