ABSTRACT

In the present study a micromechanics based damage mesomodel for the initiation and propagation of fiber breaking and fiber-matrix debonding has been developed for unidirectional continuous fibrous composites under quasi-static loading. Two micromechanics based methods have been used for the analysis of an RVE which contains a circular fiber in a square matrix along with a thin interphase/interface between fiber and matrix. This RVE is assumed to be repeating to represent the entire lamina. The state of micro stress and micro strain in fiber, matrix and interphase is found from Hill's concentration factors. Hill's concentration factors are calculated using two different micromechanical approaches namely mechanics of solids approach and homogenization. The model has separate damage indicators for each mechanism on continuum level. The fiber breaking damage is modeled as brittle. The fiber-matrix interphase debonding is modeled as ductile. The initiation of debonding in interphase is predicted from tensile and shear strengths of matrix. The models for these damage mechanisms use the micro stresses and strains. The evolution of diffuse damage parameters is done using two approaches. The first approach involves calculation of the strain concentration factors at no debonding and at 80% debonding and expressing the damage parameter as a function of the strain concentration factors. The second approach involves expressing the damage parameter in terms of the strain. The relationship between the damage parameter and the strain is found by using experimentally determined stress-strain curves, and finding a relationship between the stress and strain using a least square fit. From the relationship between stress and strain, a relationship between damage and strain is found. The present model is tested separately for these mechanisms without considering the effect of one on other. The model is tested for T300/Epoxy composite. The results obtained for damage initiation and propagation are in good agreement with the results reported in open literature.