A numerical study of the influence of microvoids in the transverse mechanical response of unidirectional composites

The effect of porosity on the transverse mechanical properties of unidirectional fiber-reinforced composites is studied by means of computational micromechanics. The composite behavior is simulated by the finite element analysis of a representative volume element of the composite microstructure in which the random distribution of fibers and the voids are explicitly included. Two types of voids - interfiber voids and matrix voids - were included in the microstructure and the actual damage mechanisms in the composite, namely matrix and interface failure, were accounted for. It was found that porosity (in the range 1-5%) led to a large reduction in the transverse strength and the influence of both types of voids in the onset and propagation of damage throughout the microstructure was studied under transverse tension and compression. Finally, the failure locus of the composite lamina under transverse tension/compression and out-of-plane shear was obtained by means of computational micromechanics and compared with the predictions of Puck's model and with experimental data available in the literature. The results show that the strength of composites is significantly reduced by the presence of voids. © 2014 Elsevier Ltd.