Abstract

The behaviour of composite materials under external loads is often quite different from that of an isotropic material. The failure of composite is due to the accumulation of micro-level failure events. So it is important to have a fundamental understanding of micro-level failure mechanisms. The compressive failure of the aligned fiber composite has received significant attention in recent years because it typically occurs at stress levels 50-60% less than the tensile strength. Kink band formation and propagation has been recognized as the primary compressive failure mechanism of unidirectional fiber reinforced composites. There is enough experimental evidence to suggest that kink band formation is controlled by fiber misalignment and the shear yield strength of the matrix. Kink band formation is sudden and catastrophic in nature. Because of its catastrophic behaviour it is very difficult to capture the failure response.

The present work is an attempt to simulate the kink band formation in uniaxial composites. The kink band formation in uniaxial composite laminates is investigated using two dimensional micromechanical model. The model includes a local imperfection to initiate the kink band locally. Imperfections are provided on central fibers in the form of fiber waviness. The imperfection length is fixed and the effect of imperfection length on kink band formation is not considered in this analysis.

The analysis is performed for glass/epoxy composite and carbon/epoxy composite. In order to study the effect of number of fiber imperfections on kink band formation, analysis is done for glass/epoxy composite with single fiber imperfection and multiple fiber imperfection. A close look into the shear stress developed on the matrix adjacent to the fiber imperfection, gives a good knowledge about the kinking mechanism. Fiber rotation inside the kink band, kink band width and the nature of composite failure matches well with the experimental observations.