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Fracture Simulation of Short Fiber Composites Considering a Mechanical Property with the Multiscale Approach

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Predicting the mechanical properties of fiber-reinforced plastics is essential for estimating the strength of structures. The multi-scale analysis framework can evaluate macroscopic mechanical properties by expressing the microstructure of an object composed of fibers and resins in unit cells. The effect of fiber orientation can be considered when applying the calculated homogenized material properties to macro-scale analyses. In this study, we will conduct a fundamental study on the establishment of failure criteria that can be used for the strength prediction of structures by considering failure in the macro-scale analysis of fiber reinforced plastics. Figure 1 shows the optimized result of the stress-strain curve. The elastoplastic material parameters for microstructure are determined.

Moreover, the results of the macro-scale simulation of tensile testing that evaluated the properties of homogenized materials and set the fracture criteria are discussed. Figure 2 and Figure 3 show the distribution of von Mises stress. These two models involve different fiber orientations. Figure 4 shows the cracked model. This simulation uses the three threshold in order to estimate the crack initiation.

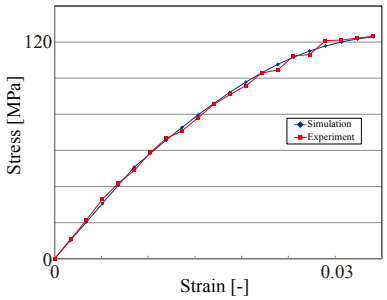

Figure 1 Optimized result of stress-strain curve

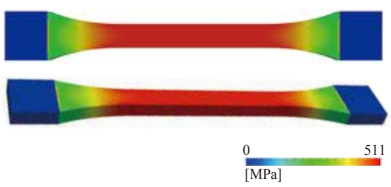

Figure 2 Distribution of von Mises stress of uniform fiber orientation

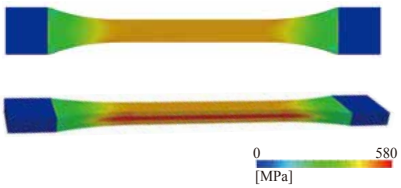

Figure 3 Distribution of von Mises stress of layered fiber orientation

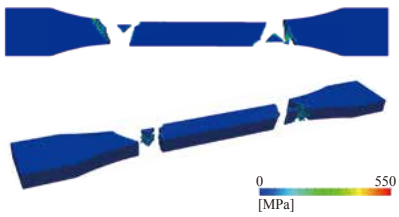

Figure 4 Cracked model