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Fiber Cross-Section Shape Effect on Rate-Dependent Behavior of Polymer Matrix Composites with Fiber Bragg Grating Sensors

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A strain measurement system with fiber Bragg grating (FBG) sensors is developed to monitor the quasistatic/dynamic strain in a glass/epoxy for the experimental analysis of the rate-dependent behavior of polymer matrix composites (PMCs). The rate-dependent inelastic constitutive relationship of epoxy is built using an internal state variable viscoplasticity model with experimental responses. The micromechanical investigation of fiber shape effect on the rate-dependent behavior of glass/epoxy for various off-axis angles is performed at 10^{-5} and 1/s. The results indicate that a higher strain rate causes a greater flow stress in PMCs. The fiber shape evidently affects the inelastic deformation at large off-axis angle with the biggest stiffness provided by the square fiber, but has little impact on the elastic deformation for all off-axis angles. The effect of fiber shapes on overall responses is enhanced with increasing off-axis angles but weakens with increasing strain rate.

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