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A new geometry to evaluate the strain rate sensitivity of Mode II Interfacial Shear Strength in CFRPs

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Extended Abstract

Abstract

This work presents a new specimen geometry designed to analyze the strain-rate sensitivity of Mode II interfacial shear strength (IFSS) in carbon-fiber reinforced polymers (CFRPs) under compressive loading. Since interfacial mechanisms such as fiber–matrix debonding and frictional sliding strongly influence composite energy dissipation and macroscopic shear/off-axis strength, robust characterization of IFSS—especially at high rates—remains essential. Existing micromechanical approaches (e.g., microbond, fragmentation, push-in/out, pull-out) often yield scattered results and may not represent the stress-state complexity of real composites, while high-rate studies are comparatively scarce. To address these limitations, the proposed macroscale design concentrates shear stresses into two narrow regions while minimizing tensile and mixed-mode contributions, enabling a more representative assessment of interface-dominated failure. Specimens were manufactured from a 3 mm-thick AS4/8552 unidirectional laminate using water-jet cutting followed by machining and grinding, with the fiber direction aligned with the compression axis and careful control of contact-face flatness and parallelism. Two regimes were investigated using the same geometry: quasi-static tests on an electromechanical universal machine and dynamic tests using a Split Hopkinson Pressure Bar. The stress state and deformation fields were analyzed through digital image correlation (DIC) and a supporting finite element model (ABAQUS/Explicit). The observed fracture response is consistent with prior literature, and dynamic testing suggests that inertial effects reduce sensitivity to non-symmetrical loading. Overall, the new geometry is a practical and effective route to study fiber/matrix interface behavior, particularly under dynamic conditions.

Keywords:

CFRP shear test strain rate sensitivity dynamic loading