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In situ experimental investigation on the out-plane damage evolution of 3D woven carbon-fiber reinforced composites

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Abstract

The damage evolution study on 3D woven carbon-fiber reinforced composites has always been a challenge to the research community. In this paper, a new *in situ* experimental method is proposed to realize the non-destructive observation of the failure process of 3D woven carbon-fiber reinforced composites. Synchrotron radiation computer tomography (SRCT), an *in situ* load frame and new-style specimens are integrated. With the method, the 3D crack initiation and propagation can be continuously recorded by the SRCT scanner. Through analyzing the experimental results, the out-plane failure mechanism under tension and shear loads is found. Particularly, it is shown that the interface property is the leading factor affecting out-plane strengths. Moreover, the effect of braiding angle on the out-plane strengths in different directions is discussed. According to the failure modes, it can be concluded that with the increasing of the braiding angle, the out-plane tension strength will increase but the out-plane shear strength will decrease. The proposed *in situ* experimental method and the above findings are significant to calibration of failure prediction model and the novel design of woven composites.

Keywords: *In situ* experiment; Synchrotron radiation computer tomography