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Title: Delamination analysis of CFRP laminates exposed to lightning strike considering cooling process

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Abstract

This study examined the damage mechanisms of CFRP laminates exposed to lightning strike. Simulated lightning current testing elucidated the CFRP laminate damage behavior. Thermogravimetric analysis results revealed the pyrolysis behavior. Coupled thermal–electrical analysis, heat transfer analysis, and stress analysis using cohesive elements were conducted using finite element method (FEM) incorporating a CFRP thermal decomposition model. Delamination was simulated using a cohesive-element model. As results, it was revealed that the consideration of cooling processes after the application of impulse current is significantly important as elucidating the lightning strike damage mechanism. Numerical analysis results corresponded with experimentally obtained results, but with a smaller delamination area, which implied that reduced interlaminar strength (fracture toughness) attributable to the progress of thermal decomposition accompanying heat generation dominated delamination from lightning strike damage. In addition, other phenomena including mechanical loading also affect lightning strike damage.

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Key words:

Damage; Delamination, Electrical properties; Thermal properties; Cohesive interface modeling; Progressive damage analysis

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