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Investigation of the Structural Integrity of Embedded Device Composites

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ABSTRACT

Functional devices integrating within the structural materials are a key way to implement and design the multifunctional materials and structures. However, the embedded device in a composite structure would generally cause a geometric discontinuity that result in a significant effect on the structural integrity. Some of the key issues in affecting the structural integrity have been explored experimentally and numerically in this paper. During static tensile testing, the damage evolution was monitored by acoustic emission measurement, and several specimens were observed through optical micrograph at different load levels to determine the progressive damage development. Testing results show that delamination at the interface between composite and integrated device is a significant damage mechanism in tensile performance degradation, and the delamination propagation depends on the ply angle of SUS/Θ interface. A two-dimensional plane strain finite element model using ABAQUS code was developed to study damage initiation using stress analysis and the behavior for delamination propagation using a fracture mechanics approach. Numerical results show that it can be modeled the different effects of “slipping” and “frictional” on crack propagation to introduce different critical release rate.

Keywords: multifunctional structures; structural integrity; delamination; finite element analysis; fracture mechanics