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A new approach in testing fatigue fracture mechanics properties in asymmetrical bonded composite/metal assemblies

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Abstract

In aeronautics the weight of a structure is important and its strength is crucial. Composite structures are more and more used for their lightness and their high performance in fatigue solicitations. Nevertheless, metallic materials remain essential for some functions, which sometimes lead to the creation of hybrid structures, achievable with the use of bonding techniques. The bonding of metallic materials over composite, requires accurate knowledge of bonding properties in static and fatigue, including the capability to perform a residual strength assessment in case of local damage such as a discrete disbond. In order to test the fracture mechanics properties of the adhesive, modified specimens such as the Double Cantilever Beam (DCB) were used. Because of the materials' stiffness difference, they were specially designed to produce a pure mode I in the crack plane. The strain energy release rate, G, was chosen as the governing fracture parameter. The classic way to test specimens in fatigue is controlling the displacement (or the force) of the actuator. The new approach proposed in this paper, consists in controlling the variation of energy (ΔG) during the fatigue tests, thus a user-specified constant value of ΔG will be applied on the specimens. The purpose of this work is to compare the classical Paris' law, obtained by using a controlled force feedback, and the fatigue law obtained with an energy control. The advantages of the new approach will be described.

Keywords: Energy control, structural composites, adhesive, damage tolerance, fatigue tests, mode I