ON THE FRACTURE HEALING RESPONSE OF AN AERONAUTIC-GRADE FIBER REINFORCED EPOXY VITRIMER COMPOSITE

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Delamination is the most prevalent failure mode in composite materials, and several attempts to mitigate this phenomenon are being investigated in the aerospace field so far. The approach adopted in this investigation involves the implementation of a healable high-performance epoxy vitrimer, characterized by a unique reversible reaction allowing reshuffling of disulfide covalent bonds within its basic molecular structure, as the matrix phase. The mendability of the fiber reinforced composite was tested through mode II fracture toughness tests, and the results were supported through surface optical analysis, thermal scanning, and crack propagation observations by way of R-curves. The effect of varying the dynamic covalent bonds concentration in the mixture composing the matrix phase was also investigated, and a clear trade-off between the composite's operational temperature range and its healing properties was observed. The specimens with the best repair abilities showed an average and maximum recorded first healing efficiencies of 89% and 95% respectively, while they averaged a steady 50% efficiency after several repairing cycles. Finally, optical fibers equipped with FBG sensors were implemented in the specimens to study the internal stresses and material behavior during healing, while also assessing the specimens' behavior before and after healing during mechanical testing.