

Dual-Layer Fiber-Reinforced Polysiloxane Composite with Ablative Nanocomposites Layer and Glass Support Layer

by

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ABSTRACT

A dual-layer (DL) composite system with a top ablator layer and bottom insulative structural layer was designed, fabricated, and characterized for potential use as a thermal protection system. DL composites allow for functionality across the dimension of the material. For example, a high-density carbon fiber composite offers excellent ablation performance while a lower density glass fiber composite offers good insulation property and weight savings. The top ablator layer was approximately 30% of the total composite thickness, with the remaining 70% for the bottom insulative layer. The 3:7 ratio can be modified depending on the amount of thermal protection needed on a given mission. Two methods of bonding the different layers were used. One method involved joining via molding compound and the second method was joining with a high temperature graphite adhesive. Nanoceramic filler was added to the ablator level to study potential improvements in material performance. This project was divided into three phases: First, a loading study to evaluate nanoceramic fillers in both quartz and carbon ablator composites where the best performing candidate was selected for full-scale fabrication and testing. The second stage involved fabrication, processing, and machining of six composite panels. Three control composites along with three DL systems were fabricated for evaluation. The final stage of this project was material analysis. Bond strength testing was performed to compare the methods of joining the composites and an oxyacetylene test bed (OTB) aerothermal test was used to evaluate the composites ablation performance.