Novel Thermal Coating for High-Speed Airplanes

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In comparison to various other materials, Carbon Fiber, specifically Carbon Fiber Reinforced Polymers (CFRP), is pre-eminent amongst other materials for use on aeronautical systems. Due to its high specific strength (strength-to-weight ratio), CFRP is prominent for carrying heavy loads while maintaining a lightweight build. However, when influenced by heat resulting from air resistance, CFRP is known to undergo serious degradation that would significantly decrease the effectiveness of the polymers. To prevent this degradation and maintain the strength of the CFRP, thermal protective layers (TPLs) are designed to shield the CFRP from heat exposure. This research is focused on the examination of the effectiveness of a specific hybrid TPL composed of epoxy resins and buckypaper (carbon nanotubes). Heat gun and heating plate tests will be used at temperatures of 200-250°C to examine these specific properties at these temperatures. The effectiveness of the specific thermal resistance of TPL will be examined by analysis of its ability to successfully cause heat dispersion across the face surface with minimal heat allowed through the axis perpendicular to the front surface. Front and back surface temperature measurements will be performed to test these properties from both contact and non-contact temperature measuring devices. Additionally, there will also be thermal composite analysis performed through finite element analysis (FEA) simulations on Ansys using the steady-state thermal analysis system. To supplement the thermal property examination, the mechanical strength properties of these composites will also be analyzed before and after heat exposure through FEA simulations on Ansys using the static structural simulation analysis system. This mechanical analysis will allow for a stronger comprehension of the thermal protection's effectiveness in improving the Carbon Fiber's retention of strength after heat exposure. The results from the experiment and simulation will be collectively used to determine the TPL's potential success in the aerospace industry.