Thermal Barrier Coating for Carbon Fiber-Reinforced Plastic Composites

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Abstract

In order to use CFRP composites in a high-temperature environment, a coating that can effectively block external heat is required. TBC (Thermal barrier coating) has generally been studied for the purpose of mechanical and corrosion protection of metal materials at high temperatures. Recently, research has been conducted to effectively reduce thermal conductivity by controlling the pores of the TBC layer. This study aims to introduce a non-combustible TBC layer on a CFRP substrate to protect it from high temperatures. A bilayer composed of yttria-stabilized zirconia (YSZ) - polyetheretherketone (PEEK) was fabricated using a flame spray technique, and its high-temperature characteristics were investigated. The thermal property analysis results show that the thermal conductivity of the entire coating layer can be controlled by controlling the porosity. In particular, the decrease in thermal conductivity becomes much more pronounced as the PEEK feed rate increases because of the presence of many pores. These pores effectively reduce the overall thermal conductivity of the porous TBC layer through convective heat transfer, especially when there is a temperature gradient between the interior and the surface of the TBC. Through the thermal shock test, the surface temperature of the CFRP heated to 500∘C exceeded 300∘C in 300s and started to ignite. In contrast, the surface temperature of the TBC-coated CFRP specimen was maintained at 230 ∘C for 10 min, and no spontaneous ignition or combustion was observed.

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