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PROPERTIES OF CARBON REINFORCED POLYBENZOXAZINE RESIN COMPOSITES – AN
ABLATIVE MATERIAL WITH NEW STRUCTURE

Abstract

Carbon reinforced phenolic resin composites have been used to produce ablative thermal protection components such as the exit cone of the solid rocket motor due to its excellent ablative property and good processing ability. The interlaminar strength of the carbon reinforced phenolic resin composite by tape wrapping processing is low because of its two dimensional structure. As a result, the defect of delamination is usually formed in the material, leading to abnormal ablative erosion. To increase the interlaminar strength of the ablative thermal protection components such as the exit cone of the solid rocket motor, the reinforcement fiber should be introduced at the direction perpendicular to the lamina of the tape. This kind of ablative thermal protection material is manufactured by carbon fiber preform and Resin Transfer Molding (RTM) processing. The carbon fiber preform is prepared by stitch processing and the properties of carbon reinforced polybenzoxazine resin composites with new structure were presented in this paper. The property and processing parameters of the polybenzoxazine resin were introduced. Then the properties of carbon reinforced polybenzoxazine resin composites were studied. Finally, a carbon reinforced polybenzoxazine resin composites exit cone was produced by RTM processing. The results indicated, the tensile strength, tensile modulus, elongation at break, compression strength, compression modulus, density and Tg of the polybenzoxazine resin are 47.4MPa, 5.41GPa, 0.94%, 118.7MPa, 3.56GPa, 1.193g/cm³ and 247, respectively. And the percentage of residual carbon for the polybenzoxazine resin at the temperature of 800 and 900 are 51.87% and 51.09% by thermogravimetric analysis. The viscosity of the polybenzoxazine resin at different temperature was measured, and the variation of viscosity in 5 hours at 105, 110, 115 and 120 was measured too. The viscosity of the cyanate ester resin in 5 hours at 110 was not above 300 mPa•s. As a result, the processing parameters of the polybenzoxazine resin were obtained. The tensile strength, tensile modulus, flexural strength, flexural modulus, and interlaminar shear strength of the carbon reinforced polybenzoxazine resin composites are 457.4MPa, 49.4GPa, 452.8MPa, 44.1GPa and 35.6MPa, respectively. The erosion for oxyacetylene ablation and thermal conductivity of the composites

are -0.021mm/s and $0.690\text{W/m}\cdot\text{K}$ respectively. The exit cone was designed according to the mechanical and ablative properties of the carbon reinforced polybenzoxazine resin composites. Eventually, the carbon reinforced polybenzoxazine resin composites exit cone was produced by RTM processing and tested.