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Improved high-temperature mechanical property of carbon-phenolic composites by introducing titanium diboride particles

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Abstract

The effect of TiB_2 on the thermal stability of phenolic and the role of TiB_2 on the high-temperature mechanical property of carbon–phenolic composites are investigated by introducing TiB_2 particles into phenolic, and then TiB_2 particles into carbon–phenolic composites. The thermal stability of phenolic is enhanced by TiB_2 additions. And the enhancement in thermal stability of phenolic exhibits a positive effect on improving the high-temperature mechanical property of carbon–phenolic composites. The flexural strength at 1000 °C of carbon–phenolic composites is increased by 148.2% after introducing 20 wt% TiB_2 particles into phenolic matrix. In the heating stage before high-temperature mechanical test, TiB_2 particles react with oxygen or oxygen-containing molecules released by phenolic pyrolysis. As a result, amorphous carbon coated with glassy B_2O_3 and ceramic particles forms a new compact matrix. The well-bonded interface provides TiB_2 modified carbon–phenolic improved mechanical performance at high temperature.

Keywords:
Polymer-matrix composites (PMCs);
Compression moulding;
Thermal stability;
High-temperature mechanical property.

1. Introduction

Carbon-fiber-reinforced composite materials have been known to be useful for the purpose of ablation resistance [1-6]. Specially, in moderate ablation environments, the carbon–phenolic (C–Ph) composites are considered extensively to be efficient ablative thermal protection materials [2,7-14]. When the C-Ph composites are subjected to ablative conditions in air, it would be most desirable if the fiber reinforcement and matrix retain their own structure, property and shape to as great an extent and far as long as possible[15,16]. Therefore, it is also an urgent requirement to improve the high-temperature mechanical properties of C–Ph composites while improving their ablative properties.

Many studies are aimed at improving the mechanical properties of C-Ph composites at room temperature [17-19]. Recently, different kinds of additions, such as nanosilica and carbon nanotubes (CNTs) have been used to improve the mechanical properties of C-Ph composites. Mirzapour A et al. [20] manufactured the nano-SiO_2/carbon fiber/phenolic composites using nano-SiO_2, short-cut carbon fiber

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