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Lightweight chopped carbon fibre reinforced silica-phenolic resin aerogel nanocomposite: facile preparation, properties and application to thermal protection

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Abstract: A chopped carbon fibre (CF) reinforced silica-phenolic resin (Si/PR) aerogel nanocomposite was prepared through a simple one-pot sol-gel polymerization in a slurry of CF, PR, silane, hexamethylenetetramine and ethylene glycol. CFs were distributed homogeneously and randomly in the Si/PR aerogels. The Si/PR aerogels exhibit finer microstructure, higher thermal stability and better anti-oxidation resistance than PR aerogels. The compressive strength for the composites with low densities between 0.402 to 0.463 g/cm^3 ranged from 0.33 to 2.44 MPa and thermal conductivities from 0.089 to 0.116 W/(mK), respectively. Furthermore, the CF/Si/PR aerogel nanocomposites could deliver linear ablation rates as low as 0.117 mm/s, and internal temperature peaks approximately 100 °C at 38 mm in-depth position as the surface temperature exceeded 2000 °C in oxyacetylene flame. From mentioned above, this lightweight composite presents huge application prospects in thermal protection and heat insulation field, especially in aerospace industry.

Keywords: Carbon fibres; Resins; Strength; Thermal properties.

1. Introduction

Aerogels, monolithic three-dimensional (3D) cellular solids of various colloidal particles, have