INFLUENCE OF SIC ON THE OXIDATION RESISTANCE OF CARBON FIBRE REINFORCED UHTCMCS

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Ultra-High-Temperature-Ceramics (UHTCs) are a novel class of refractory materials characterized by melting points exceeding 3000°C and very good thermo-mechanical properties [1]. In particular, ZrB_2 composites have been extensively investigated as potential candidates for the fabrication of reusable Thermal Protection Systems (TPS) for aerospace applications due to their relatively low density and high thermal conductivity. The main drawbacks are the low oxidation resistance of ZrB_2 above 1000°C, due to the formation of a porous ZrO_2 scale and evaporation of B_2O_3, and low fracture toughness. Silicon carbide has been found to increase its oxidation resistance up to 1650 owing to the formation of a protective, viscous borosilicate scale [2][3]. However, their low fracture toughness and thermal shock resistance remain major obstacles for their application [4][5]. For this purpose, continuous carbon fibres (~45 vol.%) were used as reinforcement in order to increase their fracture toughness and thermal shock resistance. The resulting materials were labeled “UHTCMCs” (Ultra High Temperature Ceramic Matrix Composites).

In the present work, the oxidation resistance of carbon fibre reinforced ZrB_2/SiC composites was studied. Composites with SiC amounts ranging from 5-20 vol.% were fabricated by slurry infiltration and hot pressing at 1900°C and 40 MPa.

Oxidation tests were carried out on cut specimen (2 x 2.5 x 12 mm^3) in a bottom-up loading furnace at 1500°C and 1650°C. The resulting microstructures were analysed by SEM-EDS and X-ray diffraction analysis. Weight loss per surface area was recorded after each test.

Results show that the formation of a viscous borosilicate glass phase is essential for the protection of carbon fibres from oxidation; low amounts of SiC do not provide enough protection against fibre degradation, but with increasing the SiC amount there is an increase in the thickness of the protective layer and a decrease in weight loss.

References

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