PROCESSING AND CHARACTERIZATION OF LAYERED UHTCMCs REINFORCED WITH CONTINUOUS OR DISCONTINUOUS CARBON FIBRES

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Key Words: UHTCMC, lightweight, oxidation resistance, mechanical properties, gradient structures

Ceramic matrix composites (CMC) with an ultra-high temperature ceramic (UTHC) matrix are very promising materials for aerospace and defense applications due to the high oxidation and ablation resistance coupled with high temperature mechanical properties. The main limitation is the high specific weight of the UHTC matrix that results in a composite density above 4 g/cm^3. Recent approaches have shown how the use of layered structures with gradient compositions can overcome this limitation, significantly reducing the composite weight while still maintaining desired oxidation resistance and damage tolerance.

In this talk, novel graded structures were manufactured and characterized. The challenge was the production of high ablation resistant materials with a UHTC-rich surface and a lightweight core. A new technique for the synthesis of UHTCMCs with short Cf has been recently developed. This technique allows the fabrication of thin (~ 100 µm), flexible and easy to handle sheets suitable for fabricating homogeneous or layered green structures without the use of organic solvents that can be further consolidated by sintering. A large range of compositions, in terms of matrix and fibre volumetric content - from 0% to 100% is possible. When sheets with the same composition were overlapped, dense samples with high homogeneity and no memory of the layer-by-layer technique were obtained. Planar graded structures with crack free, sharp interfaces were manufactured overlapping sheets with carbon fibre reinforcement varying from 50 to 0%.

In parallel, using continuous Cf preforms, composites with a SiC-rich core coupled with UHTC-rich surface either containing ZrB_2 or HfB_2, were produced by slurry impregnation and sintering to enhance resistance to oxidation and achieve lightness. Besides mechanical properties, short oxidation tests up to 1650°C in conventional air furnace and arc-jet tests up to 2000°C were carried out for selected materials.

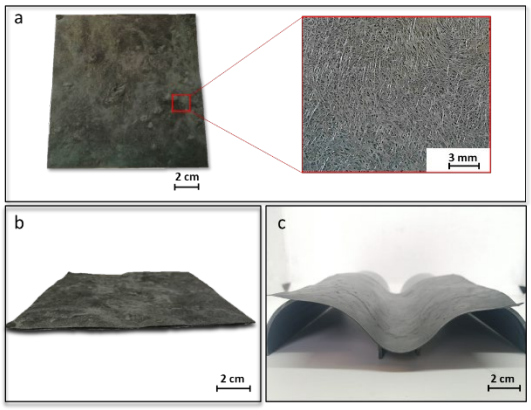

Figure 1 – Green morphology of thin sheets containing ZrB_2 and short carbon fibres