

HTMS Insights: Elevating Oxide/Oxide CMCs into Strategic Focus

In a recent article featured by Composite World in September 2023¹, the increasing interest in Ceramic Matrix Composites (CMCs) came to the forefront, particularly within Europe. The subject has witnessed a notable surge in interest as evidenced by an influx of over 5000 technical papers since 2020. Within the domain of Ceramic Matrix Composites, there are two primary classifications: Oxide-based ceramics and Non-Oxide based CMCs. It is the Oxide/Oxide CMC that is emerging as a focal point over recent years in Europe.

Traditionally confined to specialised sectors such as defence, nuclear, and aerospace, the adoption of CMCs has encountered limited penetration owing to their high cost. However, an examination of the cost in more detail, considering the fibres and manufacturing processes separately, reveals that Ox/Ox CMCs are carving out a unique space as an economically viable alternative to high temperature metallic options such as Nickel Superalloys, Figure 1. This is primarily attributed to the cost-effectiveness of oxide fibres in contrast to their Non-Oxide counterparts like Silicon Carbide (SiC). Whilst acknowledging the cost advantage of oxide fibres, it is essential to recognise the superior performance metrics of SiC fibres in terms of strength, stiffness, and maximum temperature capability, particularly dominated by creep performance.

¹ https://www.compositesworld.com/articles/a-new-era-for-ceramic-matrix-composites



Figure 1 - A successful application of Ox/Ox CMC has been in the exhaust section of military aircraft.

The strategic appeal of Oxide-based CMCs is further underscored by their inherent resistance to oxidation, a crucial attribute in the domain of hightemperature materials. Beyond cost considerations, the manufacturing processes of Ox/Ox CMCs is similar to that of Polymer Matrix Composites, distinguishing themselves from their non-oxide counterparts. This entails slurry impregnation into the fibre, laying up, and consolidating the part in a press or autoclave, followed by sintering at temperatures below 1200°C. Post basic machining processes, the Ox/Ox CMC part is ready for high temperature applications.

However, the performance-to-cost ratio remains a pertinent consideration for sectors driven by cost sensitivity, contributing to the relatively modest penetration of Ox/Ox CMCs. In response, HTMS is positioned at the forefront, revolutionising the Ox/Ox CMC market by introducing high-performance CMCs with robust cost-effectiveness and an inherently lower CO₂ manufacturing process. This innovative leap is achieved through the development of a novel matrix chemistry, requiring significantly lower sintering temperatures compared to the standard Ox/Ox CMC process.

A cost-effective Ox/Ox CMC not only presents opportunities for diverse applications but signifies a transformative breakthrough across various industries. Envision, for instance, an electric vehicle battery case that can withstanding routine exposures to 1000°C without compromising it's mechanical properties. HTMS's advancements signal not just a strategic shift but a new journey in propelling Oxide/Oxide CMCs into the future of high temperature thermal protection.