Presented at 36th International Conference and Exposition on Advanced Ceramics and Composites (ICACC), Daytona Beach- Florida, January 22-27, 2012

TaB_2-based ceramics: microstructure, mechanical properties and oxidation resistance

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ABSTRACT

Among ultra-high temperature ceramics, major attention has been devoted to zirconium and hafnium borides and carbides. Tantalum composites remain a less explored class of ceramics.

In this contribution, TaB_2-based ceramics were hot pressed with addition of 5-10 vol% $MoSi_2$. Temperatures in the range of 1680-1780°C led to relative density around 90-95%. The microstructure was studied through X-ray diffraction, scanning and transmission electron microscopy and the results enabled the rebuilding of the densification mechanisms occurring upon sintering.

The hardness was about 18 GPa, the fracture toughness 4.6 $MPam^{1/2}$ and the room temperature flexural strength was around 630 MPa, but abruptly decreased to 220 MPa at 1200°C.

The composite containing 10 vol% of $MoSi_2$ was tested in a bottom-up furnace in the temperature range 1200-1700°C for 30 minutes. The microstructure appeared covered by a SiO_2 layer, but the bulk remained unaltered up to 1600°C. At 1700°C the specimen vaporized. Nanoindentation was employed on the oxidized cross section to detect eventual mechanical properties modification associated to chemical/microstructural change.