MICROSTRUCTURE MODIFICATION OF EB-PVD GADOLINIUM ZIRCONATE THERMAL BARRIER COATINGS AND THE EFFECT ON THEIR RESISTANCE AGAINST SILICEOUS CMAS MELTS

Christoph Mikulla, German Aerospace Center (DLR) Cologne, Germany
christoph.mikulla@dlr.de
Ravisankar Naraparaju DLR, Cologne, Germany
Peter Mechnich DLR, Cologne, Germany
Uwe Schulz DLR, Cologne, Germany

Keywords: CMAS, TBCs, Gadolinium Zirconate, rare earth zirconates, EB-PVD

Gadolinium zirconate TBCs are proven to be very effective in restricting the CMAS attack by forming quick crystalline reaction products such as apatite and garnet that seal the porosity against infiltration. However, the microstructural effects on the efficacy of GZO against CMAS attack is less explored and especially the microstructures that are obtained by the Electron Beam-Physical Vapor Deposition method. Several distinct GZO microstructures are created by EB-PVD deposition method and assessed with regard to their microstructural characteristics. The response of selected microstructures to CMAS melts with different chemical compositions was studied for up to 50h at 1250°C.

An optimized columnar microstructures with smaller intercolumnar gaps and long featherarms was found to significantly lower the CMAS infiltration compare to those microstructures created with standard parameters. The formation the reaction products such as Apatite, Fluorite, Garnet etc. was found to be strongly dependent on the CMAS melt composition as well as on the local microstructure. Garnet, which formed as a continuous layer on top of Apatite and Fluorite, is identified as a beneficial reaction product that improves the CMAS resistance, as it slows down the consumption of GZO, binds high amounts of CMAS and stabilizes the subjacent Apatite-Fluorite reaction layer.