High temperature oxidation studies of a PVD based EBC system on SiC-SiC_f substrates under water vapor atmospheres

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Rare earth silicates are currently being used as environmental barrier coatings (EBCs) to protect ceramic matrix composite (CMCs) against environmental degradation. Atmospheric plasma spraying (APS) is the widely accepted state-of- the art methodology to deposit EBCs and the Si bond coat. However, novel processing methods are needed to produce crystalline and phase pure EBCs to overcome the draw backs of APS. Electron beam physical vapor deposition (EB-PVD) is widely used to deposit thermal barrier coatings (TBCs) and has been used here to deposit Si-based bond coats on CMC substrates for the first time. The surface roughness of the CMC substrate has proven to be an influencing factor for getting uniform and dense Si-coatings. Upon high temperature oxidation under air and water vapor at 1300°C up to several hundreds of hours in a tube furnace, a clear difference in the SiO_2 oxide scale growth has been observed. Water vapor has enhanced the oxide scale growth by a factor of 2.

A PVD based EBC system consisting of a double layer Yb di- and mono-silicate was deposited on top of Si bond coated CMCs. High temperature isothermal oxidation tests under water vapor at 1300°C have shown the protective nature of the EBCs. The oxidation kinetics of the bond coat were reduced under the presence of EBCs. The microstructure of the EBC system and phase changes were investigated in order to understand the corresponding degradation mechanisms that are related to water vapor attack.