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CERAMIC MATRIX COMPOSITE ENVIRONMENTAL PROTECTION STRATEGIES

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Ceramic matrix composite components based upon SiC fibers and matrices are beginning to be used in aircraft engines. However, the formation of gaseous silicon hydroxides at the temperatures and pressures present within the hot section of the engine results in volatilization of their normally protective oxide scale leading to SiC recession rates significantly greater than 1μm/hr at engine operating temperatures (in the 1300^{o}C-1350^{o}C range) and pressures**.** CMC components must therefore be coated with a prime reliant environmental barrier coating (EBC) that impedes the transport of water vapor to the composite surface. We have used air plasma methods to deposit tri-layer rare earth silicate/mullite/silicon coatings on a-SiC substrates, and have investigated the mechanisms of damage in water vapor rich thermal cycling environments and during exposure to liquid calcium aluminum magnesium silicate. We find that rapid delamination of the coating system can occur in steam rich environments when the coefficient of thermal expansion of the outer, rare earth silicate layer is not matched to that of the substrate. Silicon volatilization during the deposition process is also found to lead to the formation of multi-phase rare earth silicate layers from mono-phase powder. The substantial thermal expansion mismatch between these rare earth silicate phases then leads to equiaxed microcracking within the rare earth silicate layer, and this has been linked to rapid permeation of molten silicate deposits in some EBC systems.