CONCEPTS FOR ENHANCING THE LIFE OF ENVIRONMENTAL COATINGS SYSTEMS

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Current environmental barrier coatings systems for SiC composites utilize a silicon bond coat and ytterbium disilicate (YbDS) environmental barrier layer. During use in the water vapor laden and remnant oxygen rich combustion gas environments, failure can occur by volatilization of the environmental barrier and by oxidation of the bond coat resulting in the development of high driving forces for coating layer cracking and coating system spallation. This presentation explores concepts for delaying these failure mechanisms. In one approach, a duplex bond coat concept is investigated in which a thin (~ 5 μm thick) layer of m-HfO2 is vapor deposited on the silicon bond coat surface prior to the application of the YbDS layer by air plasma spray deposition. As water vapor and oxygen permeate to the silicon-m-HfO2 interface, crystalline silica is formed which, upon cooling through 240 ^{o}C during thermal cycling, results in a large (4-5%) reduction in volume and development of substantial elastic strain energies in the coating system. However, as the oxide layer thickness increases, some of the silica reacts with hafnia to form hafnium silicate (hafnon) which has a thermal expansion coefficient similar to silicon and therefore results in a reduction of the risk of coating fracture. Preliminary investigations aimed at also slowing the kinetics of the silica formation reaction and rate of YbDS volatilization through thermal barrier coatings and the design of mixed rare earth disilicates will also be discussed, and the challenges confronting these approaches will be discussed.