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NASA'S ADVANCED ENVIRONMENTAL BARRIER COATINGS DEVELOPMENT FOR SIC/SIC CERAMIC MATRIX COMPOSITES: UNDERSTANDING CMAS DEGRADATIONS AND RESISTANCE

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Environmental barrier coatings (EBCs) and SiC/SiC ceramic matrix composites (CMCs) systems will play a crucial role in next generation turbine engines for hot-section component applications because of their ability to significantly increase engine operating temperatures with improved efficiency, reduce engine weight and cooling requirements. The development of prime-reliant environmental barrier coatings is essential to the viability and reliability of the envisioned CMC engine component applications, ensuring integrated EBC-CMC system durability and designs are achievable for successful applications of the game-changing component technologies and lifing methodologies.

This paper will emphasize recent NASA environmental barrier coating developments for SiC/SiC turbine airfoil components, utilizing advanced coating compositions, state-of-the-art processing methods, and combined mechanical and environment testing and durability evaluations. The coating-CMC degradations in the engine fatigue-creep and operating environments are particularly complex; one of the important coating development aspects is to better understand engine environmental interactions and coating life debits, and we have particularly addressed the effect of Calcium-Magnesium-Alumino-Silicate (CMAS) from road sand or volcano-ash deposits on the durability of the environmental barrier coating systems, and how the temperature capability, stability and cyclic life of the candidate rare earth oxide and silicate coating systems will be impacted in the presence of the CMAS at high temperatures and under simulated heat flux conditions. Advanced environmental barrier coating systems, including HfO_2-Si with rare earth dopant based bond coat systems, will be discussed for the performance improvements to achieve better temperature capability and CMAS resistance for future engine operating conditions.

Keywords: Environmental barrier coatings; Ceramic Matrix Composites (CMCs); Calcium-Magnesium-Alumino-Silicate (CMAS)