Interfacial Stability of Multilayer Nanostructured Thermal and Environmental Barrier Coatings for Aerospace Applications

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Improving turbine engine performance is critical for meeting NASA goals and objectives. New high-temperature materials with light-weight, high-strength, low-cost and non-strategic compositions are needed to replace performance-limited metallic-based turbine components. Ceramic matrix composite (CMC) materials are attractive candidates for turbine hot-section components. Unfortunately, direct exposure to combustion environments leads to degradation via corrosion, volatilization and associated surface recession. To protect against these challenges, various thermal and environmental barrier coatings (T/EBCs) have been engineered for CMC turbine hot-section components. While current T/EBC systems demonstrate some protection of CMC components, multilayered and nanostructured T/EBC systems are required to increase thermal, erosion and corrosion protection and durability (>2000 hours) through cyclic operation to temperatures in excess of 1600°C.

The aim of this NASA-EPSCoR (MSGC) project is to improve fundamental understanding of high-temperature corrosion mechanisms of model and novel T/EBC systems within combustion environments. T/EBC systems will be deposited on various CMC substrates using physical vapor deposition equipment in the Montana Microfabrication Facility. Research will focus on interfacial stability within multilayer T/EBCs as a function of exposure to precisely-controlled combustion environments using instruments in the Image and Chemical Analysis Laboratory and the PI's laboratory at Montana State University. The PI and students will work closely with and visit researchers at NASA-Glenn Research Center (Protective Coatings Branch) to discuss T/EBC materials, testing methods, results and analysis. Thermodynamic and transport models will be developed to help explain degradation mechanisms and facilitate improved protection strategies.

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