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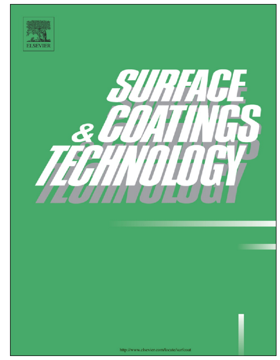

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Layered, Composite, and Doped Thermal Barrier Coatings Exposed to Sand Laden Flows within a Gas Turbine Engine: Microstructural Evolution, Mechanical Properties, and CMAS Deposition

Andy Nieto[a*], Michael Walock[a], Anindya Ghoshal[a*], Dongming Zhu[b], William Gamble[c], Blake Barnett[c], Muthuvel Murugan[a], Marc Pepi[c], Chris Rowe[d], Robert Pegg[d]

[a] Vehicle Technology Directorate, US Army Research Laboratory, Aberdeen Proving Ground, MD, 21005, USA

[b] Environmental Effects and Coatings Branch, NASA Glenn Research Center, Cleveland, OH, 44135, USA

[c] Weapons and Materials Research Directorate, US Army Research Laboratory, Aberdeen Proving Ground, MD, 21005, USA

[d] Power & Propulsion, US Navy Naval Air Systems Command, Patuxent River, MD, 20670, USA

Abstract

This study investigates several thermal barrier coating (TBC) architectural approaches for maintaining damage tolerance and attaining improved resistance to molten environmental particulate (i.e., CMAS) deposition. TBC approaches included an air plasma sprayed composite and layered coating, an electron beam-physical vapor deposition (EB-PVD) doped coating, and an EB-PVD bilayer doped coating. The TBCs were evaluated under sand laden combustion flows within a gas turbine engine. Scanning electron microscopy (SEM) and nanoindentation were used to characterize the microstructural and mechanical property evolution to understand the effects of the engine conditions on the various microstructural architectures and compositions investigated. The CMAS accumulation on each TBC is characterized and the nature of interaction at the TBC/CMAS interface was characterized by SEM, focused ion beam milling/imaging, and energy dispersive spectroscopy. An air plasma sprayed composite YSZ/Gd_2O_3 coating with a thin ~10 μm Gd_2O_3 top coat performed the best, as it exhibited the lowest CMAS deposition and the least amount of structural damage.