DEVELOPMENT OF ENVIRONMENTAL BARRIER COATINGS VIA PVD TECHNIQUES: EVALUATION UNDER HIGH TEMPERATURE WATER VAPOR

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Environmental barrier coatings (EBCs) are proven to protect SiC-based materials against water vapor in gas turbine environments. The straightforward EBCs are typically comprised of two layers, ytterbium disilicates (YbDS) and a Si bond coat, and are applied by atmospherically plasma spraying (APS) method. YbDS offers high-temperature phase stability. However, it still experiences a detrimental volatilization rate under a high-velocity steam environment. Yttrium disilicate (YDS), on the other hand, exhibits better water vapor and CMAS resistance but lacks the high-temperature phase stability. While the use of RE-mono silicates, RE-disilicates, or multi-component for EBC or T/EBC (thermal environmental barrier coatings) is still under debate, efforts are required to produce dense, uniform, crack-free layers that have good adherence through complex geometries components. Physical vapor deposition, e.g., magnetron sputtering or electron beam physical vapor deposition (EB-PVD), can provide good adhesion through sharper-edged and improve the accommodation of CTE by columnar and/or dense microstructure.

This study presents a comparative analysis of two advanced deposition techniques—magnetron sputtering and EB-PVD—for the fabrication of EBCs and their performance under a water vapor environment at high temperatures. Successfully, two different double-layer EBC systems were deposited by PVD techniques, the first based on Y silicates and the second (Y,Yb) silicates. The water vapor parameters consist of 30% H_2O/70%O_2, at 1300°C. The results showed, in coated conditions, dense EB-PVD layers while magnetron sputtering a columnar microstructure both with in amorphous states. After crystallization, the monoclinic X2-monosilicates and β-disilicates phases constituted the final EBCs. The changes after the crystallization and water vapor test will be discussed in terms of morphology, crystalline phase, and chemistry of the coatings.