CMAS REACTIVE COATINGS FOR TBCS

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Degradation of thermal barrier coatings (TBCs) from calcium-magnesium-alumino-silicate (CMAS) deposits is a well-established failure mechanism seen in TBCs exposed to extreme temperatures in environments where silicious deposits are ingested [1,2]. By infiltrating the TBC and both damaging compliance and destabilizing the microstructure, CMAS can lead to premature spallation of the coating, thereby motivating the need for CMAS resilient TBCs [1,2]. In this work, a ceramic topcoat, termed TBC-Shield (TBC-S), is proposed. TBC-S is a thin, conformal coating comprised of a rare-earth containing ceramic. The rare earth is designed to react with CMAS on the surface of a TBC coated component in the hot gas path. As CMAS is introduced to the TBC-S, a reaction takes place, consuming both the CMAS and the TBC-S. The products of the TBC-S/CMAS reaction will then flake off, leaving only remaining TBC-S and a chemically changed CMAS composition with an increased melting temperature. This results in reduced CMAS infiltration into the TBC and is demonstrated to increase the life of a TBC by at least 50% compared to a TBC without TBC-S. TBC-S is applied on-wing on substrates that have CMAS/dust deposits, and it can be applied to a variety of TBC types, including thermally sprayed or EB-PVD. The coating is deposited using a room temperature spray process with no additional heat treatment needed. To optimize the adhesive/cohesive strength of this coating, a ceramic binder is added to the formulation.

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[2] Kramer, S., Yang, J., Levi, C. G., Johnson, C. A., "Thermochemical Interaction of Thermal Barrier coatings with molten CaO-MgO-Al2O3-SiO2 (CMAS) deposits," J. Am. Ceram. Soc. 89 [10] p. 3167-3175 (2006)