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Engineered multi-layered thermal barrier coatings for enhanced durability

Sanjay Sampath
Center for Thermal Spray Research, Stony Brook University, sanjay.sampath@stonybrook.edu

Vaishak Viswanathan
Center for Thermal Spray Research, Stony Brook University

Gopal Dwivedi
Center for Thermal Spray Research, Stony Brook University

ENGINEERED MULTI-LAYERED THERMAL BARRIER COATINGS FOR ENHANCED DURABILITY

Sanjay Sampath, Center for Thermal Spray Research, Stony Brook University
sanjay.sampath@stonybrook.edu

Vaishak Viswanathan, Center for Thermal Spray Research, Stony Brook University
Gopal Dwivedi, Center for Thermal Spray Research, Stony Brook University

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The durability of plasma sprayed thermal barrier coatings has been of significant interest ever since their inception in gas turbine engine components. Although several novel materials are being developed, 7-8% YSZ continues to serve as the industry standard. One of the major reasons being the penalty of lower fracture toughness associated with these novel TBC materials. While toughness is an essential component in determining the spallation life of coatings, the elastic energy present in the coatings is almost equally critical. Since the failure of typical APS coatings occur at the interface of the bond coat and topcoat due to the strains associated with TGO growth, the toughness is most critical at that particular interface. We experimentally demonstrate that by functionally optimizing the location specific needs of toughness and modulus via a multilayered TBC architecture, the furnace cycle of coatings can be significantly improved. Thus by leveraging the benefits of process science we present a durability strategy for APS YSZ coatings. Additional embodiments of this approach include multilayer incorporation of alternate lower toughness zirconates to mitigate against other damage mechanisms such as CMAS.