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Lifetime and Failure Modes of Plasma Sprayed Thermal Barrier Coatings in Thermal Gradient Rig Tests with Simultaneous CMAS Injection

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Abstract

Degradation of thermal barrier coatings (TBCs) in gas-turbine engines due to calcium–magnesium–aluminosilicate (CMAS) glassy deposits from various sources such as sand, volcanic ash, fly ash, or variable quality fuels has been a tenacious issue during the recent years. This follows from the fact that engines are required to operate under increasingly harsh conditions in all kind of gas turbine applications following the demands for higher efficiency and operational flexibility. While the understanding of the mechanism of CMAS induced degradation of TBCs as well as approaches for mitigation of CMAS attack by means of advanced TBC compositions have grown remarkably, most of the reported results have been obtained from lab testing at isothermal conditions or from evaluation of ex-service components, either. The isothermal tests are not reproducing important thermomechanical effects from service conditions, and it may be hard to figure out the thermal history of the ex-service examples.

In this study a burner rig facility has been used for the evaluation of TBC performance, where a thermal gradient is applied across the TBC at cyclic load and CMAS is continuously