

THE INFLUENCE OF THERMAL TRANSIENT RATES ON TBC SPALLATION

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During rapid engine throttling operations, turbine airfoils can experience very rapid heating and cooling. These rapid transient events lead to the generation of very high thermal gradients, and consequently, larger non-uniform stress distribution through the thermal barrier coating (TBC) and substrate, which in turn leads to faster coating spallation. To study this phenomenon, a burner rig was designed and built to test coupons under these rapid transient thermal conditions. Coupons were tested to failure under different transient rates. The tests were also simulated using coupled aerothermal CFD and the thermal profiles were matched to the experiment. A fracture mechanics model was also developed to calculate energy release rates under these transient thermal loading. Rationalization of TBC spallation models reported in the literature and our own finite element model with experimental results was done. The details of the experimental set-up, coupon test results, and model correlation with test results will be presented.