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ABSTRACT
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PHYSICS-BASED MODEL ASSISTED AGE PREDICTION OF REAL-SERVICED THERMAL BARRIER COATED SAMPLES USING INFRARED THERMOGRAPHY

In this study, age prediction model is developed for the real serviced thermal Barrier coated (TBC) samples. Thermal Barrier Coating (TBC) is a multilayer coating applied on metallic structures exposed to high temperatures, such as gas turbine blades and aero-engine parts, to extend the operational life. During the service, a thermally grown oxide (TGO) layer forms at the interface between the ceramic topcoat layer and the bond coat layer as a function of time. Oxide layer growth is the primary cause of TBC performance decline and structure failure. As a result, monitoring the formation of the oxide layer is crucial for determining the component's life and making maintenance decisions. One of the main challenges for developing an age prediction model are unavailability of serviced samples and labeled dataset. So, in this study experimentally validated numerical models are used for data generation. This study considers three types of samples with different service times, i.e., newly coated, 500 hours, and 1000 hours. The thermal aging of TBC samples is monitored using a non-invasive and non-destructive thermal imaging technique. The transient temperature profiles of samples exhibit significant variation due to the different thermal aging. We have developed the 1-D numerical model using a commercial finite-element package to understand physics better, and the results show good agreement with experiment data. Using the pulsed thermal imaging experiment data and multilayer heat transfer model data, we developed a model for predicting the service time of the TBC samples.