

In-Depth and In-Plane Diffusivity Measurement of the Thermal Barrier Coating by IR camera: Evaluation of Aging

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Ceramic Thermal Barrier Coatings (TBC) are widely applied for protecting hot path components from the combustion gases in gas turbines for both aero- and land-based applications. TBC undergo degradation and eventually detach from their substrate. The forecasting of the detachment of TBC for timely maintenance is an open problem in gas turbine technology. It is known that sintering happens in the TBC when they are exposed to high temperatures. Sintering affects the mechanical properties of TBC, and mainly their strain compliance, the degradation of which causes detachment. As sintering also strongly affects the thermal diffusivity of TBC, the idea is to measure the latter parameter to account for the former.

Pulsed Thermography is the technique selected to monitor the diffusivity variation due to TBC ageing. It should be applied to monitor the gas turbine during the normal stop for maintenance. This paper reports preliminary laboratory tests carried out on a set of metal samples covered with TBC, which were prepared and aged in the oven, at various percentages of their estimated life, where the end of life is defined as the time of detachment from the substrate.

The TBC surface of the sample is heated with a laser spot with a diameter of 1 cm and duration of 1 ms. The temperature image of the spot and its surroundings is collected with an IR camera at high velocity (150 Hz sampling rate) and a sequence of images is recorded for later analysis.

The heat transfer model that leads to the identification of diffusivity in the coating layer is described in the general case of anisotropic conductivity.

Data obtained for in-depth and in-plane diffusivities are reported for different degrees of aging.