Laser Flash of Semitransparent TBCs

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TBCs are applied to protect components of gas turbines from high temperature combustion gases. Typically they are metal-ceramic multi-layers structures made up of a yttria partially stabilized zirconia (7-8 wt.% Y_2O_3+ZrO_2) deposited either by APS or EB-PVD on a high temperature oxidation/corrosion resistant metallic bond coat (BC). The refractory ceramic porous layer can reduce the temperature of the base metal by 30°C to 100°C, depending on the thickness and on specific microstructural properties of the coating. Typically, thermal diffusivity of TBCs is determined by a laser flash apparatus. Unfortunately, ZrO_2 is semitransparent to near IR radiation that is typically delivered by the laser in the laser flash equipment. Moreover, the characterization of TBCs at high temperatures is particularly interesting as the typical working temperature of gas-turbine is >1000 °C. At these temperatures heat transfer is no more limited to conduction and the radiative heat transfer becomes paramount. The evaluation of effective heat conduction is carried out in this work by laser flash equipment describing at the same time common practices and countermeasures to minimize the discrepancies from the commonly used models to analyze data. The effects of blackening surfaces and covering them with thin metallic deposits is considered. The role of heat conduction and radiation is also taken into account trying to separate each contribution.