THERMAL CONDUCTIVITY OF ZIRCONIA THERMAL BARRIER COATINGS

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Thermal barrier coatings (TBCs) applied to the hot gas components of turbine engines lead to enhanced fuel efficiency and component reliability. Understanding the mechanisms which control the thermal transport behavior of the TBCs is of primary importance. Physical vapor deposition (PVD) and plasma spraying (PS) are the two most commonly used coating techniques. These techniques produce coatings with unique microstructures which control their performance and stability. The PS coatings were applied with either standard powder or hollow sphere particles. The hollow sphere particles yielded a lower density and lower thermal conductivity coating. The thermal conductivity of both fully and partially stabilized zirconia, before and after thermal aging, will be compared. The thermal conductivity of the coatings permanently increases upon exposed to high temperatures. These increases are attributed to microstructural changes within the coatings. Sintering of the as fabricated plasma sprayed lamellar structure is observed by scanning electron microscopy of coatings isothermally heat treated at temperatures greater than 1100°C. During this sintering process the planar porosity between lamella is converted to a series of small spherical pores. The change in pore morphology is the primary reason for the observed increase in thermal conductivity. This increase in thermal conductivity can be modeled using a relationship which depends on both the temperature and time of exposure. Although the PVD coatings are less susceptible to thermal aging effects, preliminary results suggest that they have a higher thermal conductivity than PS coatings, both before and after thermal aging. The increases in thermal conductivity due to thermal aging for partially stabilized plasma sprayed zirconia have been found to be less than for fully stabilized plasma sprayed zirconia coatings. The high temperature thermal diffusivity data indicate that if these coatings reach a temperature above 1100°C during operation, they will begin to lose their effectiveness as a thermal barrier.