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Effect of the Coating Parameters on the Microstructure, Hardness and Thermal Conductivity of 8 wt% Y_2O_3-ZrO_2 Thermal Barrier Coatings by Atmospheric Plasma Spray

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Abstract

Effect of the coating parameters of the atmospheric plasma spray (APS) such as gun power and standoff distance as well as the types of powders on the microstructural evolution, hardness and thermal conductivity of 8 wt% yttria (Y_2O_3) stabilized zirconia (ZrO_2), 8YSZ, coatings as a thermal barrier coating (TBC) for air- and land- based turbine system was investigated. The forming behavior of the pores and un-melt particles in the microstructure of coatings are seems to be influenced by the gun power and standoff distance including the shape of starting powder. As a result, there is an optimum condition of process parameters to obtain improved coating hardness and thermal conductivity. Regardless of the condition of standoff distance, the values of hardness were increased as the gun power increased. In the different standoff distance condition, the trend of formation of pores and un-melted particles were enhanced when too much closer or longer distance applied. And the coatings from the donut shape granules were shown higher hardness than the coatings from the spherical granules. On the other hand, for thermal conductivity of coating specimens, the values of thermal conductivities were decreased in the coating structure including more pores and un-melted particles at 470 A current condition.

Keywords: Yttria-stabilized zirconia(YSZ), Thermal barrier coating(TBC), Atmospheric plasma spray(APS), Process parameter, Thermal conductivity

1. Introduction

Yttria(Y_2O_3) stabilized zirconia(ZrO_2) (YSZ), thermal barrier coating (TBC) is known to commercialized based on the atmosphereic plasma spray(APS) method and applied to stationary and airfoil gas turbine component [1,2]. In order to improve thermal barrier performance and coating durability, such a thermal barrier coating technology has been actively studied for improving the mechanical properties and designing a coating structure capable of ensuring low thermal conductivity and structural stability at high temperatures [1.2]. Presently, the thermal conductivity and hardness values of the commercially available 6-8 wt% yttria stabilized zirconia are known to lie in the range of 1.2~1.8 W/m·K and of 3-7 GPa, respectively [3,4].

The coating by the APS method is produced through a process in which the granulated raw material powder is injected into a high temperature plasma flame and melted and then deposited in the form of a splat on a substrate having a relatively low temperature. When a coating is formed in such a manner, a formation of interlayer pores, un-melted particles, and secondary particles can be involved additionally during the typical coating structures formed by stacking of liquid droplets and can affect to the function and durability of the coating. The formation of pores in the coating structure and the remaining of un-melted particles are known to be factors that can degrade the mechanical

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