Abstract

The main objective of the work is the development of thermal barrier coatings (TBCs) by modification of the top ceramic layer and the identification of their new degradation routes. TBCs have emerged as a promising solution for improving the performance, durability, and lifespan of industrial components exposed to high temperatures, corrosive conditions, and neutron irradiation. Plasma spray (PS) technology was used to deposit bond coat (BC) and topcoat (TC) layers due to its large application in industrial sector and availability of equipment. The concept of dual phase was introduced in the topcoat layer (ZrO2-based ceramics), which is a new innovative way to fabricate TBCs with low thermal conductivity and higher thermal stability. Recently, dual phase system got much attention due to their low thermal conductivity, offer higher susceptibility at higher temperature which is the main requirement of advanced ceramic materials. Dual phase system was fabricated from commercially available advanced ceramic materials specially pyrochlore-fluorite nature of zirconates and cerates. The complex phenomenon, involving the simultaneous presence of multiple corrosive species, is extensively explored under condition of hot corrosion in molten sodium sulphate and pure oxidation. Three advanced two phase-system Gadolinium Zirconate with Yttria Stabilized Zirconia ($Gd_2Zr_2O_7$+Y_2O_3(ZrO_2)), Lanthanum Zirconate based ($La_2Zr_2O_7$+Y_2O_3(ZrO_2)), and Lanthanum Cerate ($La_2Ce_2O_7$+Y_2O_3(ZrO_2)) were investigated at the temperature of 920°C and 970°C for hot corrosion. The results revealed that the major processes involved during the degradation are phase decomposition, formation of new phase with lower and higher content of rare earth oxide, non-equilibrium diffusion process, and mutual interactions between dual phase TBCs. Visual inspection of the TBCs coatings after prolonged exposure revealed an intact ceramic layer with minor spallation only observed at the edges.

Keywords: Thermal Barrier Coatings, Hot Corrosion, High Temperature Oxidation, Degradation Routes, Dual Phase Systems, Molten Sodium Sulphate.