Service performance of the novel $Hf_6Ta_2O_{17}$ thermal barrier coatings

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Abstract $Hf_6Ta_2O_{17}$, with low thermal conductivity, high thermal expansion coefficient, and excellent fracture toughness, was a promising candidate ceramic top coat material of thermal barrier coating (TBC). A novel $Hf_6Ta_2O_{17}$/YSZ double ceramic top coat prepared by atmospheric plasma spraying (APS) was applied to study the role of the microstructure and mechanical property on the service performance at high temperatures. Results show that the rapid decomposition of $Hf_6Ta_2O_{17}$ occurred during the spraying process. HfO_2 phases were observed in the $Hf_6Ta_2O_{17}$/YSZ TBCs. Besides, the porosity of the $Hf_6Ta_2O_{17}$ ceramic top coat decreased with the increased spraying power, resulting in the elastic modulus of the $Hf_6Ta_2O_{17}$ ceramic top coat enhancement. The highest cycles at 1200 °C were obtained for the $Hf_6Ta_2O_{17}$/YSZ TBCs with the lowest elastic modulus and least HfO_2 phases, and were twice as long as the cycles of the single YSZ TBCs. The chemical reaction between HfO_2 and $Hf_6Ta_2O_{17}$ might have contributed to the cracking of the $Hf_6Ta_2O_{17}$/YSZ TBCs. This work provides a new option for the preparation and development of the ternary oxides by APS.

Keywords Thermal cycling performance; mechanical property; microstructure; $Hf_6Ta_2O_{17}$; TBCs