FACTORS INFLUENCING THE PERFORMANCE OF ZIRCONIA BASED THERMAL BARRIER COATINGS

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Thermal barrier coatings (TBCs) are an essential part of modern gas turbines which allow the use of operation temperatures above 1500°C without excessive cooling. For the standard TBC material yttria partially stabilized zirconia (YSZ) often a maximum operation temperature of 1200°C is given in the literature. However, our recent results of burner rig tests on atmospherically sprayed (APS) TBCs clearly indicate that much higher surface temperatures above 1500°C can be tolerated without early spallations. These unexpected results could be achieved by a modification of the transient phases of the burner rig tests, i.e. the heating and cooling rates were slowed down considerably to about 10K/s. Adjusting these cooling rates during the major part of the thermal cycle dramatically reduces the thermal stress in the coatings during the start of the transient phases and by this measure reduces the driving force for spallation.

In addition to the modification of the transients phases during thermal cycling, also columnar structures can significantly reduce the high tensile stresses in TBCs during cooling. Here, especially plasma spray - physical vapor deposited (PS-PVD) and suspension plasma sprayed (SPS) coatings can show promising results. Recent investigations on the thermal cycling of such columnar coatings will be presented.

Also the detrimental phase transformation of YSZ after heating to elevated temperatures can generate stresses in the TBCs. It could be demonstrated that moderate cooling rates down to low temperatures can avoid this transformation. The paper will also show recent results of cycling experiments with dwell time at moderate temperatures and their influence on the phase transformations.