ESRF	**Experiment title:** Analysis of the Temperature Dependence of the Residual Stress State in a ceramic-metal layer compound	**Experiment number:** HS 551
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Report:

Investigations have been performed at a duplex thermal barrier coating (TBC) system consisting of a plasma sprayed ZrO_2-7wt%Y_2O_3 ceramic layer with a thickness of 0.5 mm and a NiCoCrAlY bond layer with a thickness of 0.15 mm, both deposited on a Ni-superalloy In71 8 substrate with a thickness of 2 mm. The stress state has been analyzed at two different points of the ceramic layer (Zl and Z2 in fig.2) and in the bond coat (Z3 in fig.2). The spatial distribution of the residual stresses was obtained by defining a gauge volume with primary and secondary slits. The gauge volume had a width of 0.13 mm and a length of 1.3 mm.

To investigate the residual stress state of the ceramic-metal layer compound due to different temperature distributions across the sample, a special sampleholder has been developed which is shown in Fig. 1. The specimen was fixed on a water cooled plate which was mounted on an eulerian cradle. With two lamps the surface of the thermal barrier coating was heated while the backside of the substrat was cooled.

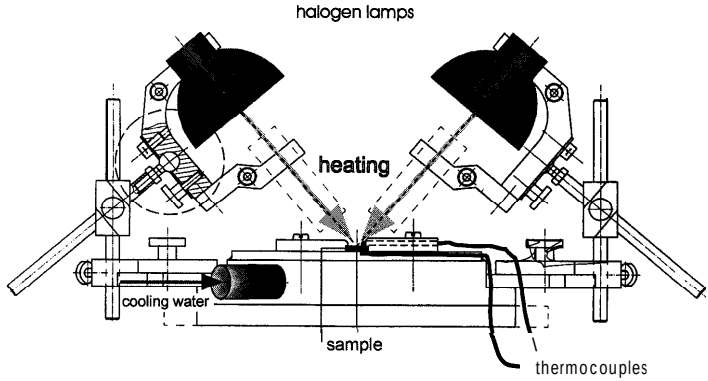

Fig. 1: Sample holder for applying defined temperature gradients to the sample (gradient oven device)

The results of the stress analysis for three different temperature gradients are shown in Fig. 2. The in-plane stresses are plotted against the absolute temperature difference between the sample surface and its backside. The temperatures for each measurement are indicated in the graph.

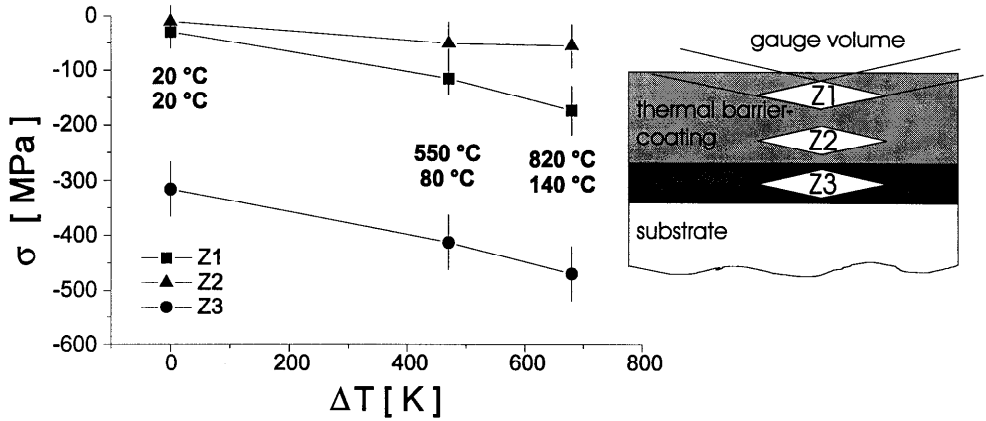

Fig. 2: Variation of the in-plane stresses in the ceramic layer (Zl and Z2) and in the bond coat (Z3) due to different temperature gradients

It can be seen that at room temperature (no temperature gradient) the ceramic layer is nearly stress free while a compressive in-plane stress can be analyzed in the bond coat. The increase of the temperature gradient causes increasing compressive stresses in the ceramic layer and in the bond coat.