ESRF	**Experiment title:** Investigation on the oxide growth in cyclic thermally treated bond coats in thermal barrier coatings and in-situ analysis of the growth mechanism and the internal stress of thermally loaded systems	**Experiment number:** ME28
Beamline: ID15a	**Date of experiment:** from: 04/05/2000 to: 10/05/2000	**Date of report:** 25.08.2000
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Report:

Investigations have been performed on a duplex thermal barrier coating (TBC) system consisting of a plasma sprayed zirconia oxide-layer with a thickness of 0.3 mm and a NoCoCrAlY bond coat layer with thickness of 0.15 mm, both deposited on a Ni superalloy In738 with a thickness of 2 mm. The stress state has been analyzed in the middle of the ceramic layer and the midle of the bondcoat layer. The spatial distribution of the residual stresses was obtained by defining the gauge volume with primary slits (0.04 x 0.04mm) and secondary slits (0.1 mm). The gauge volume had a width of 0.07 mm and a length of 1.1 mm.

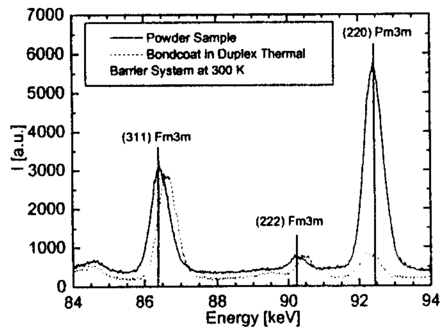

Fig. 1: *Comparison of the peak positions of the powder sample of the bondcoat material with the spectra taken from the bondcoat layer buried in the thermal barrier coating system. The data show different speak shifts related to the phases. The measurements were taken at room temperature*

The specimen was fixed on a water cooled plate and heated with two halogen lamps from the to realize the temperature gradient.

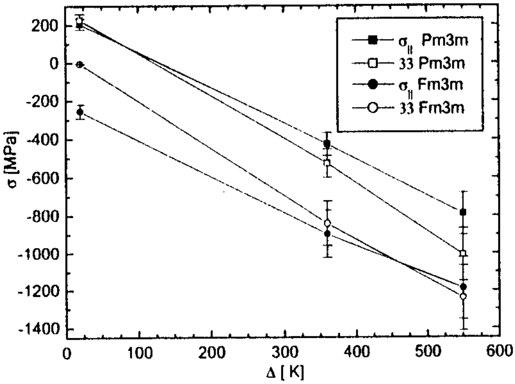

Fig. 2: *Variation of the stresses in the bondcoat layer due to different temperatures in the bondcoat layer situated in the thermal barrier coating system.*

The detector used and the low diffraction angle of 7.6° for the energy dispersive measurements allowed to resolve the two different bondcoat phases in the layer. Because of the peak separation it was possible to distinguish between the stress state of the two phases. A part of the whole spectra with indexed peaks is shown in Figure 1.

It can be seen that at room temperature one bondcoat phase shows tensile (Pm3m) while the other phase shows the same amount of compressive in-plane (Fm3m) stress. With increasing temperature the in-plane stress becomes compressive for both phases while the amout of stress of the Fm3m phase is alway higher. The result is shown in figure 2.

Further investigations were focused on the bondcoat/zirconia oxide-interface. The results are shown in figure 3 and 4.

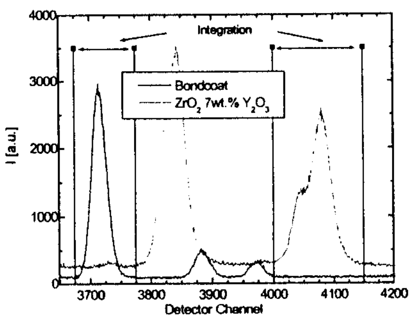

Fig. 3: *Integration areas (ROI's) for the determination of the bondcoat/zirconia oxide-interface.*

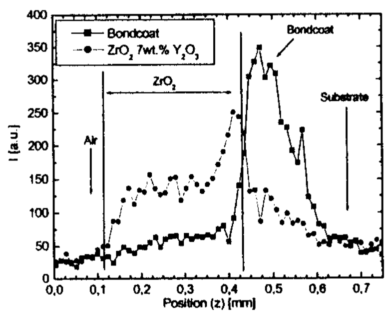

Fig. 4: *Interface determination from the ROI's as described in figure 3.*

The determination of the correct interface is essential for the analysis of the thermally grown oxide layer which is situated between both layers.