ESRF	**Experiment title:** Investigation of Residual Microstresses in PMMCs using High Energy Synchrotron Diffraction	**Experiment number:** HS - 241
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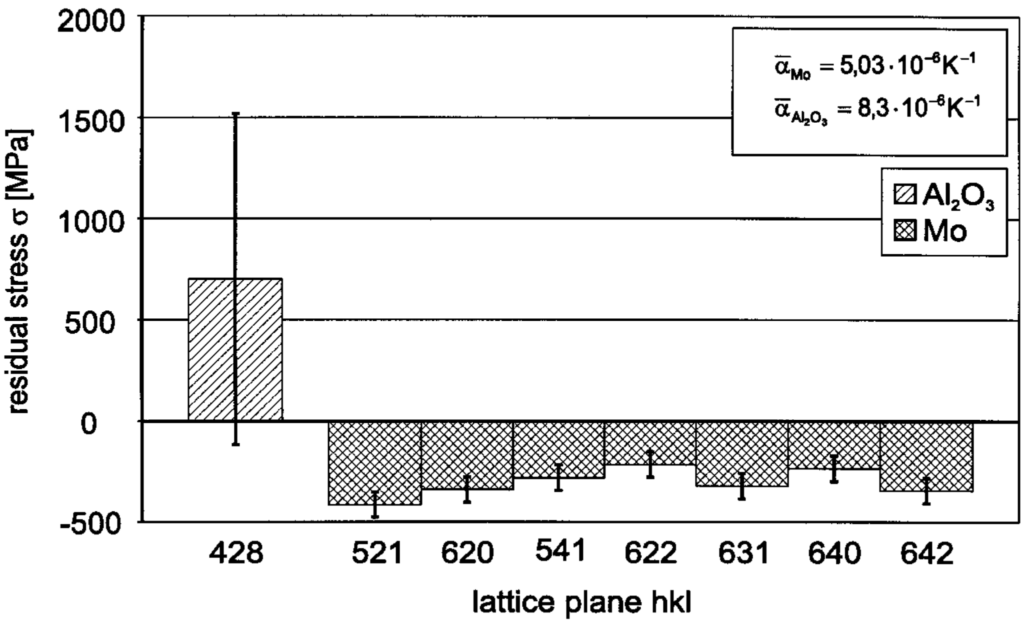
Report:

Functional gradient materials, which differ by composition, phase distribution, porosity, texture as well as related properties such as hardness, density, Young's modulus etc. offer the possibility to optimize their properties in view of the practical use. Due to the difference of the thermal expansion coefficient and the mechanical properties of the constituents residual stresses arise during cooling of a particle reinforced metal matrix composite (PMMC) from fabrication temperature to room temperature. For analyzing the residual stresses in both phases of a microwave sintered Al_2O_3 - Mo sample with a non - linear composition gradient high energy synchrotron measurements were performed. The dimensions of the sample were 35 x 15 x 10 mm^2, the gauge volume was a parallelepiped with the dimensions 1.65 mm perpendicular to the scattering vector and 0.15 mm parallel to it. The larger dimension of the gauge volume was chosen to lie perpendicular to the composition gradient and the scattering vector.

Residual stress and phases analysis were performed in the composite, additional measurements were carried out on pure Mo and Al_2O_3 in order to determine the stress-free lattice parameter of the phases. A quantitative phase analysis using the high energy synchrotron spectrum yields a composition of 27 ± 8 vol.% Al_2O_3 and 73 vol.% Mo within the gauge volume. Assuming a hydrostatic stress state within the gauge volume, the phase specific residual stress in the Al_2O_3 and the Mo was calculated.



The stress values reveal that the Al_2O_3 is under compressive and the Mo under tensile residual stresses, which is a consequence of the stronger contraction of the $A1_20_3$ during the cooling caused by its larger thermal expansion coefficient. In case of Mo the phase specific residual stress values obtained from the individual peak profiles are in good agreement. Several of the Al_2O_3 peaks, however, are superimposed on the Mo profiles. The evaluation of the few remaining $A1_20_3$ reflections due to their low intensity therefore results in a comparatively large uncertainty.