ESRF	**Experiment title:** Investigation of residual stresses and texture gradients in a hot extruded two-phase Al - alloy	**Experiment number:** HS - 549
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Report:

In cold and hot extruded samples residual stress and texture gradients arise due to strong plastic deformations, which are inhomogeneously distributed across the sample diameter. In a previous experiment the residual stresses and texture gradients were determined in a cold extruded single-phase steel sample /1,2/. Here, the residual stress and the texture gradient studies were expanded to the more complicated investigation of the macro and phase specific micro residual stresses as well as the texture gradients in a hot extruded rod of a modern high strength hyper-eutectic two-phase Aluminium-Silicon alloy AlSi25Cu4Mgl. Due to the high intensity and high parallelism of the synchrotron beam the gauge volume was a parallelepiped with the dimensions 1.65 mm perpendicular to the scattering vector and 0.15 mm parallel to it. Thus, the gauge volume was small enough, so that several volume elements could be investigated across the sample diameter. The phase specific residual stresses were determined in the Al-matrix (75 wt.-%) and the Si-particles (25 wt.-%) over the diameter (8 measuring points) of two samples that were hot extruded at 300°C resp. at 450°C. The energy spectra show that several reflections of the Si - particles and the Al - atrix overlap, but there are reflections of the Si and the Al that can be separated and evaluated properly. A comparsion of the spectra obtained in the direction parallel and perpendicular to the axis of the sample (fig.1) reveals a <100>,<111> double fibre texture that is typical for hot extruded Aluminium alloys. The results of the residual stress analyses show that compressive phase specific residual stresses (fig.2) are present in the Silicon particles while the Aluminium matrix contains the equilibriating tensile residual stresses.

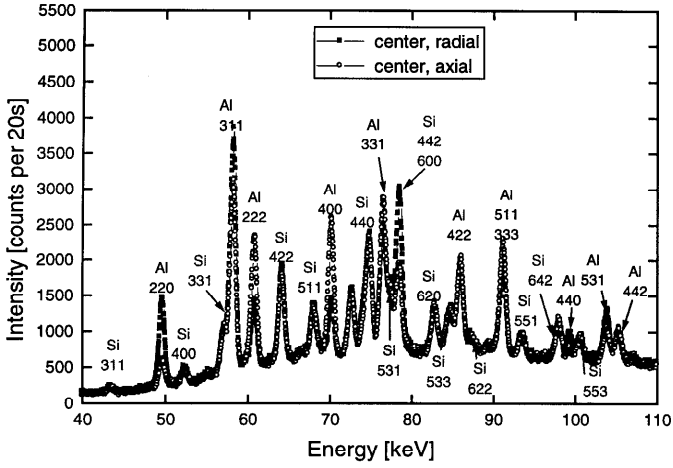

Fig..1: Energy spectrum obtained on hot extruded AlSi25Cu4Mg1

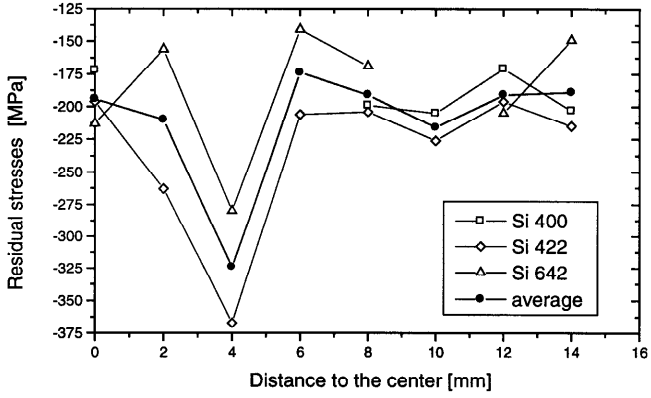

Fig.2: Phase specific residual stresses in hoop direction in the Si-particles of a hot extruded sample (extrusion temperature: 300°C)

From the phase specific residual stress values the residual macro and micro stresses were be calculated. In all three directions of the sample the macro residual stresses are small compared to the average micro residual stresses in both phases. The phase specific residual stresses and the residual micro stresses both in case of the Al - matrix and the Si particles vary among different lattice planes. This can be attributed to the strong plastic deformation and texture evolution during the extrusion process. In order to enhance the interpretation of the residual micro stresses and of the plastic deformation of the phases, analytical simulations of the deformation process are performed and the dislocation density currently is determined experimentally. A publication of the results obtained by high energy synchrotron radiation is in preparation.

/l/ W. Reimers, M. Broda, G. Brusch, D. Dantz, K.-D. Liss, A. Pyzalla, T. Schmackers, T.Tschentscher: Evaluation of Residual Stresses in the Bulk of Materials by High Energy Synchrotron Diffraction, submitted to Journal of Non-destructive Evaluation

/2/ W. Reimers, A. Pyzalla, M. Broda, G. Brusch, D. Dantz, K.-D. Liss, T. Schmackers, T.Tschentscher: The Use of High Energy Synchrotron Diffraction (HESD) for Residual Stress Analyses, submitted to J. Mat. Sci. Letters