ESRF	**Experiment title:** Investigation of residual stresses and texture gradients in Al – TiB2 particle reinforced composites and AlSi25Cu4Mg 1	**Experiment number:** HS – 986
Beamline: ID 15 A	**Date of experiment:** from: 07.11.99 to: 11.11.99	**Date of report:** 25.02.00
Shifts: 15	**Local contact(s):** T.D'Almeida, K.-D. Liss	*Received at ESRF:* - 2 MAR. 2000

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Report:

The residual stresses in the two phases of new, extruded Al6061/ TiB_2 in-situ MMCs and AlSi25Cu4Mg1 MMCs were studied in order to clarify whether residual stresses habe a significant influence on the mechanical properties of the composites. Moreover the results should give information on the origin of the residual stresses which could be either caused by the different coefficients of thermal expansion or by the extrusion process.

Samples of extruded rods of material with TiB_2 and Si were machined in a way that the macro stresses were allowed to relax. By solutionizing, water quenching and room temperature ageing comparable microstructures of the two materials were achieved.

In a further experiment the strain gradient in the extruded rod of Al6061 + 12 wt. % TiB_2, was measured for the as-delivered state without any further heat treatment. Here the d_0-value was estimated as the average value of respective crystallographic planes (random walk method). The results show no significant strain gradient across the cross section of the extruded rod.

Therefore it is not very likely that the extrusion process is the reason for the residual stresses in this material because extrusion results in strain gradients.The results of neutron and synchrotron diffraction experiments indicate that the residual stresses in Al6061/TiB_2 composites most probably derive from the different coefficients of thermal expansion.

High energy synchrotron radiation experiments allowed to quantify the residual stresses in the TiB_2 particles. For the heat treated MMCs the following values were obtained:

6 wt. % TiB_2: $\sigma(TiB_2)$=-630 MPa

12 wt.% TiB_2: $\sigma(TiB_2)$=-454 MPa

So, the compressive residual stresses in the TiB_2 particles decreased with increasing particle content. Equilibrium of forces requires tensile stresses in the matrix. Taking into account the volume fractions of TiB_2, which were determined by chemical analysis, these tensile stresses increase with increasing particle content of the matrix:

6 wt. % TiB_2: σ(Al-matrix)= 22 MPa

12 wt.% TiB_2: σ(Al-matrix)= 33 MPa

In addition in-situ tensile tests were performed. Those involving Al/TiB_2 still are under evaluation. The measurements on the reference material AlSi25Cu4 have already been evaluated (fig.1 – 4). The depalcement of the reflections due to an external strain applied at T = 300°C are shown in fig.1. Fig. 2 shows the relative intensity of the Al- reflections indicating that the 111 fibre strength increases with increasing deformation while the 100 fibre strength remains constant. Thus, recrystallisation seems to be not dominant so far. The total-strain / elastic – strain diagrams for the Si – particles and the Al-matrix (fig.3, fig.4) show the region of elastic beahviour of the composite. From these diagrams the stresses in the phases can be calculated. Also, at high strains a sgnificant increase of the fwhm of the reflections was obs

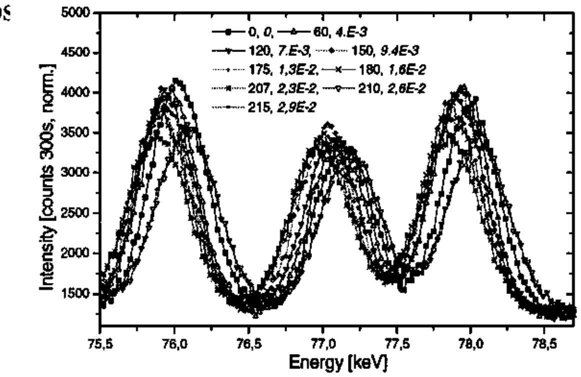

Fig. 1 Position of the reflections at different external loads and total strains

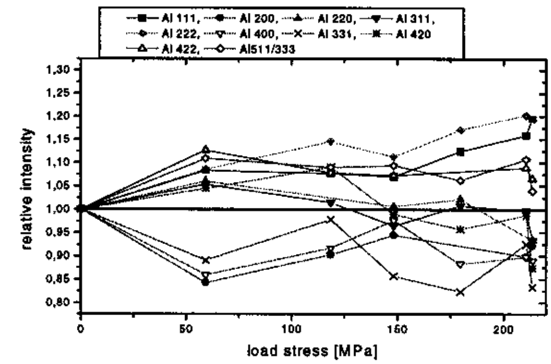

Fig. 2: Relative intensity of the Al-reflections

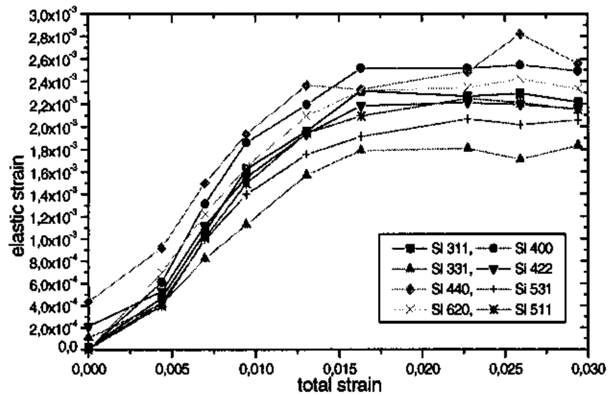

Fig. 3: Elastic Strain of the Si - particles

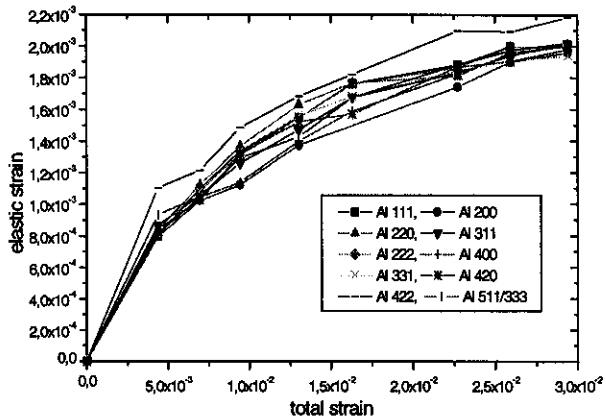

Fig. 4 Elastic strain of the Al-matrix