ESRF	**Experiment title: Investigation of the residual stress and texture development in tubular Al-alloy samples due to plastic torsional deformation**	**Experiment number**: ME-201
Beamline: BM16	**Date of experiment**: from: 27-june-01 to: 02-july-01	**Date of report**: february 2003
Shifts: 15	**Local contact(s)**: J.P. Wright	*Received at ESRF:*

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Report:

An extensive presentation and discussion of the results can be found in:

R.V. MARTINS, *Experimental Investigation of Plastically Deformed Al-Alloy Samples Using High Energy Synchrotron Radiation*, Ph.D. Thesis, TU-Berlin (2002), chapter 5.2.2, available in the ESRF library.

The two circle diffractometer on this beamline was designed for high resolution powder diffraction experiments but it could be easily modified for strain measurements on the tubular torsion samples. Due to the total thickness of the sample walls of 1.4mm, the x-ray beam with an energy of 30keV still provided sufficient penetration depth and photon flux for measurements in transmission geometry. Figure 1 shows a sketch of the experimental setup.

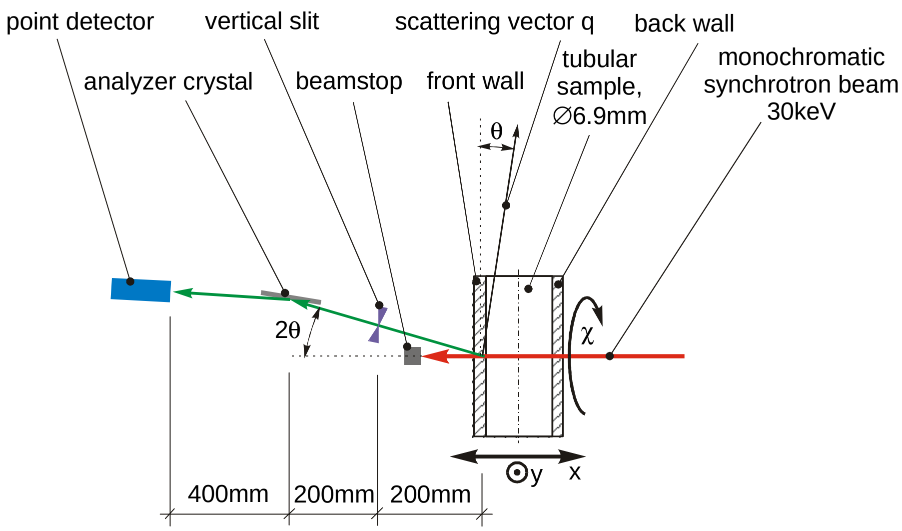

Figure 1: Experimental setup for angle dispersive technique, using analyzer crystal and point detector

The parallel beam was confined by slits to a size of 1x0.3mm^2 (h x v). A vertical slit was placed behind the sample in order to select only the signal coming from the tube wall positioned in the center of the diffractometer. A point detector in combination with an analyzer crystal was used to scan the diffraction peaks in the vertical scattering plane. A sample rotation around the incoming beam permitted measurements at different sample orientation angles χ.

A part of the results of the crystallite microstrain measurements on the tubular AlMg3 alloy torsion samples, using low energy synchrotron radiation , are presented in the figure 2. The data is plotted for the axial sample direction (i.e. S2 in sample coordinate system) in form of ε vs. $\sin^2\psi$ and intensity vs. $\sin^2\psi$ graphs. The "ψ" in the plots must not be confused with the ψ as defined in the sample coordinate system. The tangential and the axial reference direction are marked as T and A on the abscissæ respectively. Note that, due to to experimental constraints, the data for the deformation $\gamma = 0.15$ refers to the positive "ψ" branch while the higher deformations are related to the negative "ψ" branch. For each deformation step a different ex-situ deformed sample was investigated, except the sample with the lowest deformation of $\gamma = 0.15$, which was measured before and after deformation. The other samples were deformed to $\gamma = 0.30$ and 0.40. Above that deformation, bulging occurred.

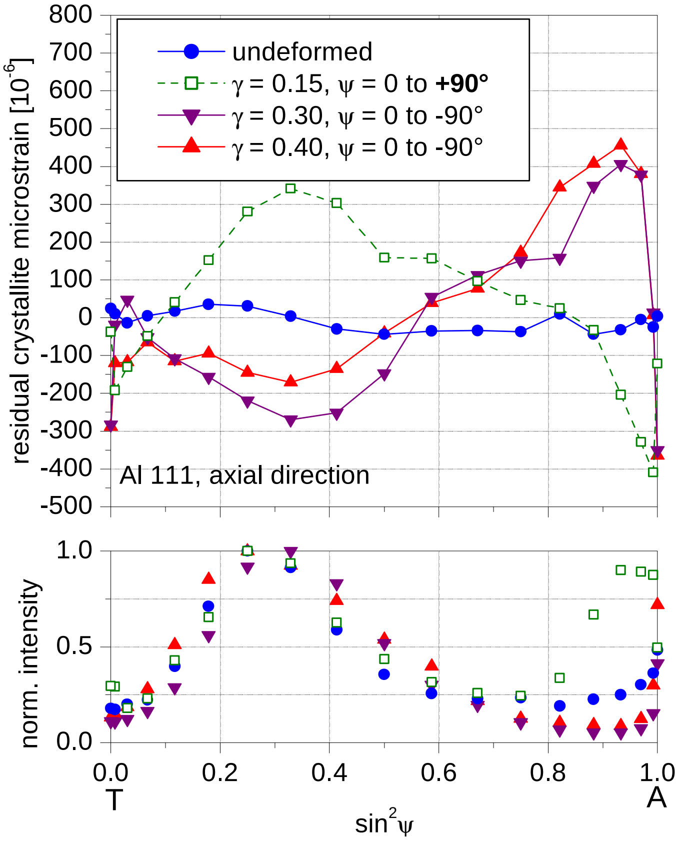

Figure 2: Crystallite microstrains measured on the Al 111 reflection in tubular AlMg3 torsion samples in different deformations. Note the different ψ range of 0° to +90° for the deformation $\gamma = 0.15$. Average error: $\pm 15 \times 10^{-6}$.

From the measurements on the undeformed sample it was concluded that the samples were basically stress-free prior to deformation. The complete data set from this sample was used to calculate the stress-free lattice parameter, which, for AlMg3, was found to be $d_0^{AlMg3} = 4.0607 \pm 5 \times 10^{-5}$Å.
For all the investigated reflections, Al 111, 200, 220, and 311, it can be observed that the peak to valley value of the microstrain oscillations decrease slightly with increasing deformation ($\gamma = 0.30$ and 0.40).