ESRF	**Experiment title:** SAXS Investigation of Void Nucleation and Growth in the Plastic Zone ahead of a Crack Tip in Ductile Metals	**Experiment number:** HC-152
Beamline: ID 13	**Date of Experiment:** from: 23. to: 26.4.95	**Date of Report:** 28.3.95
Shifts: 9	**Local contact(s):** C. Riekel	*Received at ESRF :*

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Report:

In order to study the structural changes across of the localiced plastic deformation zone ahead of a ductile crack tip the small angle X-ray scattering within the crack tip surrounding was measured. Employing a small beam focus of approximately 250 x 20 μm local differences at the deformation state can be detected. An area of 2 x 4 mm^2 ahead of the crack tips in AlMgSil and pure Al was scanned using 10 x 20 measurement points (see Fig.1). The precracked specimens had been deformed by 3-Point-bending-test to a bend of 3 mm (AlMgSil) and 4.5 mm (Al), respectively.

Figs. 2 - 4 show SAXS patterns of locations with an x-distances of 250, 500, and 1250 μm, respectively in the AlMgSil-specimen. The z-distance is 0 in all cases. The SAXS pattern of locations near to the crack tip shows a radial symmetry. Only some weak streaks are visible. With increasing distance to the crack tip the SAXS pattern show more and more a hexagonal symmetry, the number of the streaks increases and the streaks become more intensive.

Due to the fine beam cross section and the relative large grain size of the polycrystalline material scattering effects of single crystals play an important role. The streaks in the scattering patterns are caused by grain boundaries.

The hexagonal symmetry of the scattering patterns may be caused by the 12 slip systems in f.c.c. metals. Because of the oktaedrical arrangement of the slip planes always two of the slip systems can not be distinguished by the X-rays. The dislocations in the six different slip system pairs give a scattering pattern with hexagonal symmetry.

In the vicinity of the crack tip the deformation reaches a such high value, that the grain structure is destroyed. Only rests of grain boundary scattering are seen. The slip systems are randomly oriented - the scattering pattern has a radial symmetry. With increasing distance to the crack tip the deformation decreases. The grain structure remains.

Up to now the data analysis is not finished. Objective of the further analysis of the data is the quantification of the deformation gradient and the analysis of the low Q scattering ranges of the measurement points near to the crack tip in order to detect the nucleation and growth of voids. Further measurements should be done with a X-ray beam cross section smaller than 5 x 5 μm in order to investigate the deformation gradient with a better spatial resolution, especially the local changes in the nearest surrounding of the crack tip.

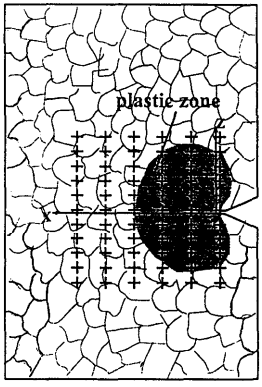

Fig.1 Schematic view of the scanning experiment

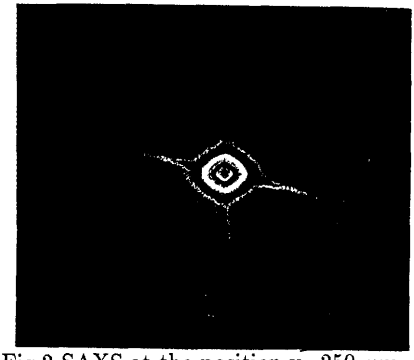

Fig.2 SAXS at the position x=250 μm

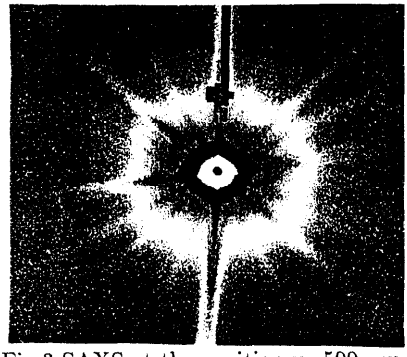

Fig.3 SAXS at the position x=500 μm

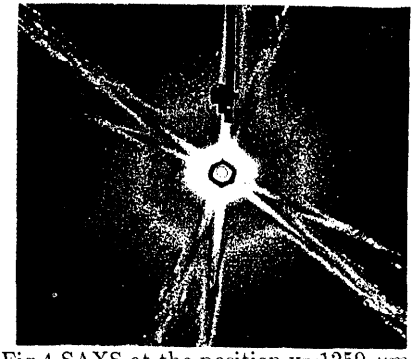

Fig.4 SAXS at the position x=1250 μm