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 281

Beamline:	**Date of Experiment:**		**Date of Report:**
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12	C. Riekl, P. Engstroem, A. Snigirew		

Names and affiliations of applicants (*indicates experimentalists):

M. Grosse* Research Centre Rossendorf Inc.

P. Nitzsche* Research Centre Rossendorf Inc.

J. Boehmert Research Centre Rossendorf Inc.

(*Experimentalists)

Report:

The knowledge about gradients in the defect structure in materials are often needed to understand the properties of these materials. Scanning Micro-Beam Small Angle Scattering (SM-SAXS) with a lateral resolution in the order of magnitude of some microns, can be an important tool for the characterisation of structural gradients in materials. The objectiv of the presented experiments was to test the possibility of the application of a Bragg-Fresnell-Lense (BFL) for SM-SAXS investigations of the damage structure in the plastic zone ahead of an crack tip in AlMg.

The experiment were performed at the "MICROFOCUS" beamline ID13. An X-ray wavelength of 1.25 Å was used. The distance between Iense and sample was 0.61 m, between sample and detector 1.27 m. The zero order interference of the BFL with an appertur of 200 μm has reduced the X-ray beam cross section at sample position to about 2 μm in diameter. A Photonic -Science CCD camera with a lateral resolution of 150 μm was used for the measurement. An arrea 100* 100 μm^2 arround the crack tip was scaned with a step width of 5 μm in both directions. The measurement time per step was 60 s. As a reference state a one dimensional scan with a length of 1 mm and also a step width of 5 μm was performed in non-deformed regions of the sample.

Fig.1-3 show typical 2D-SAXS patterns of a location near to the crack (PZ), of locations in a. distance of some millimeters from it (FR) and of the empty beam (EB) after subtraction of the high dark current background. of the used camera. In contrast to the measurements at locations fare from the crack tip the SAXS intensity measured at locations close to that is much higher than the empty beam intensity. Fig.4 compares the radial averaged SAXS intensity of the data sets of Fig. 1-3. Fig.5 shows the curve PZ after empty beam correction in the log-log-view. The exponent of the power law of 2.4 is typical for SAXS from dislocation network.

The detailed analysis of the SM-SAXS data sets is in progress and will be given else-where. The presented first results demonstrate the possibility of the application of a BFL for SAXS experiments. SM-SAXS with a lateral resolution of some microns can be a new microscopic method applicable to investigations at materials containing structural gradients.

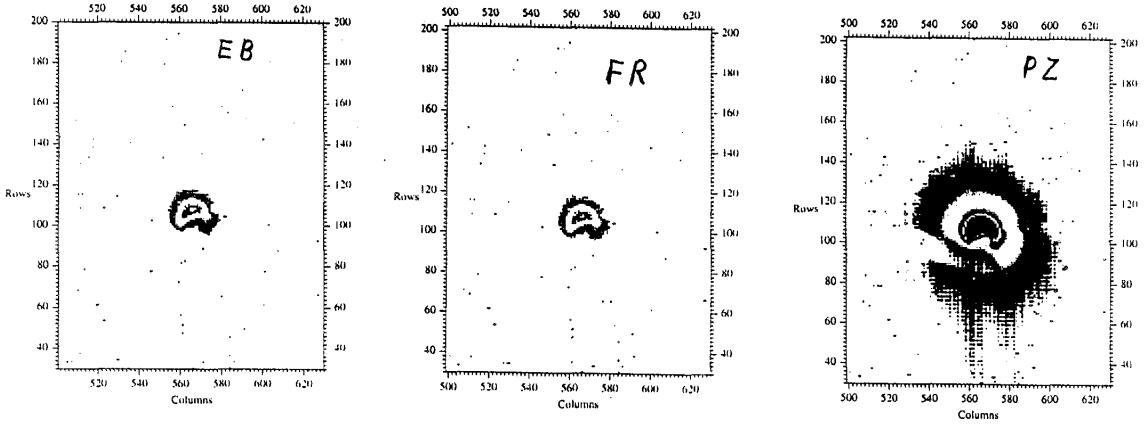

Fig.1 - 3 2D-SAXS-Patterns of a location near to the crack (PZ), of locations in a distance of some millimeters from it (FR) and of the empty beam (EB)

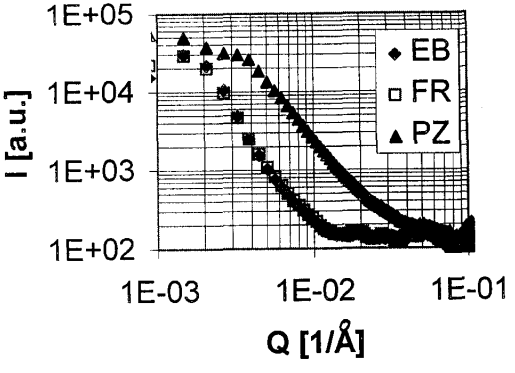

Fig. 4 Radial averaged SAXS-pattern of EB, FR and PZ

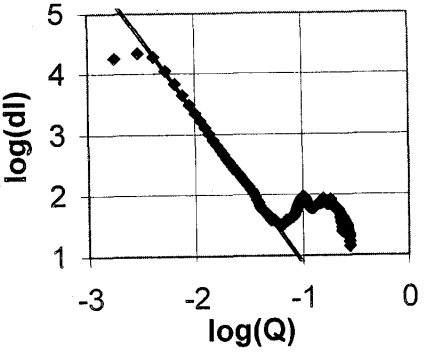

Fig. 5 Log-Log-View of the empty beam corrected curve PZ