ESRF	**Experiment title:** Bauschinger Effect at a Single Interface: New insights by X-Ray µLaue diffraction	**Experiment number**: MA1696
Beamline: BM32	**Date of experiment**: from: 07.02.2013 to: 12.02.2013	**Date of report**: 30.08.2013
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Summery:
Aim of the proposed experiment was to investigate Bauschinger effects at the micron scale by *in situ* µLaue diffraction. The experiments were performed as proposed, however, additional 3 samples which had been prepared for MA1545 were tested within MA1696.

Report:

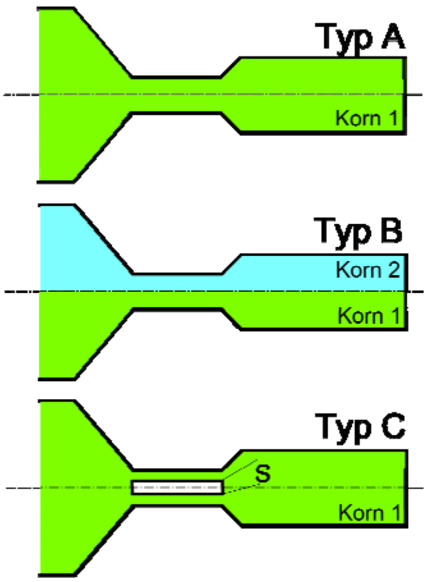

Fig. 1 Used sample geometries

15 samples (5 single crystalline, 5 bi-crystalline and 5 single crystalline with slit) have been prepared by focused ion beam (FIB) milling in our home facility. Dislocations multiplied in either compression or tension boom of the cantilever will partly move towards the neutral axis. There, the load-sign changes and thus, a dislocation pile-up forms. In case of the bi-crystalline sample the grain-boundary coincides with the grain-boundary plane and so, the pile-up is restricted in dimension with respect to the single crystal. The restriction leads to

higher pile-up stresses. In case of slit samples no pile-up will form since dislocations can escape on both, the inner and outer surface (see Fig. 1 Typ A-C).

During the experiment, we were able to use the **new setup at BM32** providing a submicron sized polychromatic x-ray beam. The µLaue end station (including beam shape recovery after thermal drift) **is very user friendly and well designed.** Small beam instabilities still need to be improved, however, did not affect our beamtime and thus, the beam time was very successful.

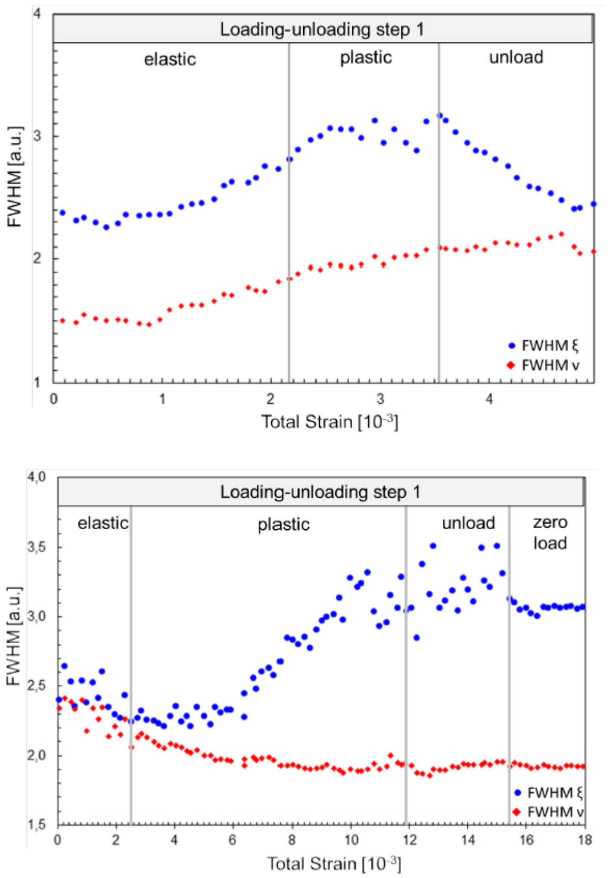

Fig. 2 Peak width evolution during the first loading step in a single crystalline sample and single crystalline with slit. In case of the single crystalline sample the peak width significantly decreases during unloading; in case of the slit it stays constant.

The in situ µLaue experiment allowed for a quantification of the Bauschinger effect and the corresponding pile-up in micron sized samples, which would not have been possible with alternative methods.

Furthermore, we were able to identify the critical role of elastic anisotropy for such kinds of experiments (in particular for the bi-crystalline sample). In addition, we were able to observe an – on the first glance not expected – activation of secondary slip systems in the slit sample. This can be explained by the alternating contribution of the shear component due to lateral forces, i.e. in the tension boom the stress on the slip system is $\tau_{ss}+ \tau_{lf}$, in the compression boom it is $-\tau_{ss}+ \tau_{lf}$. Thus, the ranking of slip systems might change, which had not been considered before. This does not affect the observation of Bauschinger effects, however needs to be discussed in case of hardening mechanisms in micro bending beams.

This effect will also be present in the single crystalline and bi-crystalline samples, however, it is hardly possible to quantify the small stress differences by x-ray µLaue diffraction and thus, no additional future efforts will be put into the investigation of this effect.

Based on the experiments within MA1696 on BM32 it is our strong believe, that the role of pile-ups for Bauschinger effects in micro bending cantilevers is clear. We are looking forward to a publication, most likely in Philosophical Magazine which will be submitted within this year.