

# Mapping the strain distribution in deformed bulk metallic glass using hard X-ray diffraction

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The main objective of this work was to follow the strain distribution within  $\text{Cu}_{45}\text{Zr}_{46.5}\text{Al}_{17}\text{Ti}_{1.5}$  bulk metallic glass undergoing bend deformation using in-situ hard X-ray diffraction. The special emphasis was placed at the observation of differences between the strain distributions within  $\text{Cu}_{45}\text{Zr}_{46.5}\text{Al}_{17}\text{Ti}_{1.5}$  bulk metallic glass when exposed to different levels of bending deformation. X-ray diffraction experiments using high-energy photons were performed at the BW5 wiggler beamline of DORIS III positron storage ring at DESY. During experiments, the beam energy was set to 100 keV. The beam cross section was set to 1 mm  $\times$  0.1 mm. Bar shaped samples having the length, width and thickness of 30, 1 and 0.5 mm, respectively. They were bended using two benders having curvature radii 10 and 20 mm, respectively. As can be seen from Fig.1a, central part of specimen undergoing bending deformation was scanned as indicated by open circles. The step size was 0.1 mm. In total about 10 different position were scanned. To improve overall statistics, about seven independent scans were taken from each position along the sample width. The strain determination of bulk metallic glasses from x-ray diffraction data is based on concepts previously reported by Poulsen *et al.* [1].

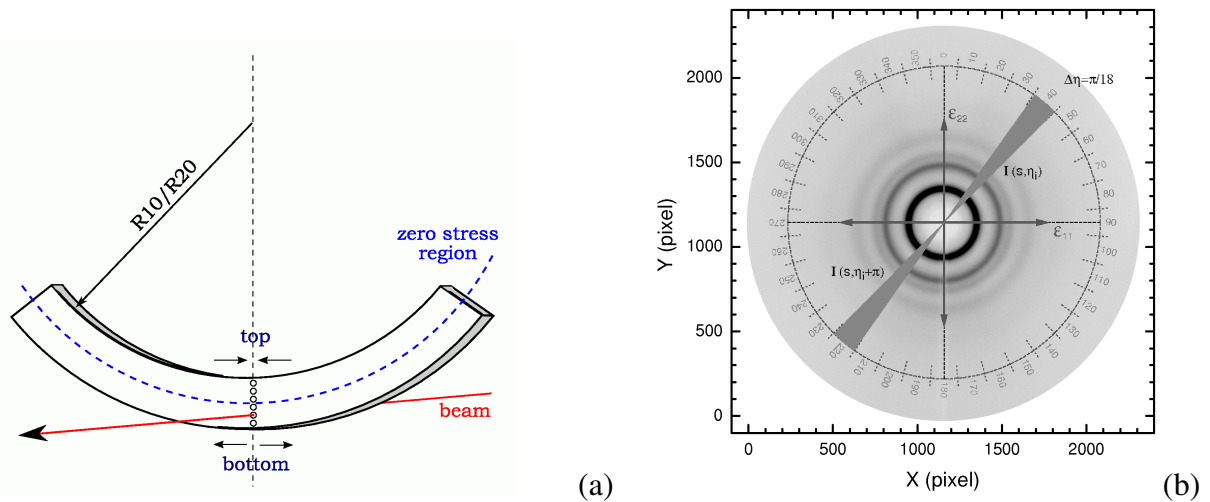


Figure 1: (a) Schematic drawing showing bending geometry and area (depicted by circles) which was investigated using high-energy X-ray diffraction. (b) Typical two-dimensional diffuse X-ray diffraction pattern of investigated alloy, together with polar coordinate system applied for quantitative strain analysis.

Doing fine scans on BMG sample exposed to bending deformation revealed that the upper part is in horizontal direction effectively compressed whereas the bottom part is effectively stretched. Comparing results for two different bending radii ( $R=10$  and  $20$  mm) we found that the zero stress region lays within the central part of the specimen. Furthermore, larger bending radius implies smoother strain gradient along the specimen width.

## References

- [1] H.F. Poulsen, J.A. Wert, J. Neufeind, V. Honkimäki, M. Daymond, Nat. Mater. 4, 33, (2005).