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# INFLUENCE OF TEMPERATURE ON THE DEFORMATION BEHAVIOR OF SINGLE- AND BI-CRYSTAL MICRO BENDING BEAMS

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The mechanical behavior of micron-scale structures varies drastically from their macro-scale counterparts. This phenomenon is known as *size effect* and has been extensively investigated for several decades. The understanding of the influence of temperature on the mechanical properties of components of electronic devices with micron or even sub-micrometer dimensions is essential for a reliable design. Hence micro-compression and micro-tension experiments on pure single-crystalline and polycrystalline face-centered cubic (fcc) metals have been carried out at different temperatures. However, in real microstructures complex stress and strain gradients arise from incompatibilities in elastic and plastic deformation, which are not addressed in tension or compression tests. Therefore, micro bending was used to study the influence of temperature on the "gradient dominated" deformation behavior. Furthermore, compared to micro-compression, micro-bending offers several advantages: one of them is that the deformed region is far away from the contact between tip and sample. This allows the study of the deformation behavior and dislocation pile-up phenomena in single- and bi-crystalline beams at high temperatures, while the temperature gradient between tip and sample may scarcely influence the results. On that account, the present work focusses on bending experiments of Cu single- and bi-crystal micro-beams at different temperatures in order to study the dislocation processes at the beams' neutral axis and the interaction between the dislocations and the grain boundaries. Therefore, *in situ* bending experiments of single- and bi-crystal micro-beams with different crystallographic orientations were carried out in a scanning electron microscope (SEM) using a nanoindenter at 300, 400 and 500 K. The micrometer-sized samples were fabricated using a two step ion milling technique: first a narrow fillet was milled with the ion slicing technique using low energy $Ar^+$ ions, and second the focused ion beam (FIB) method was used for final milling. Bending tests enable us to understand the influence of temperature on the s*ize effect*, the work hardening, the Bauschinger-effect and its correlation with plastic deformation at micron-scale (see Figure 1) as well as the temperature-dependent interaction between grain boundaries and dislocations.

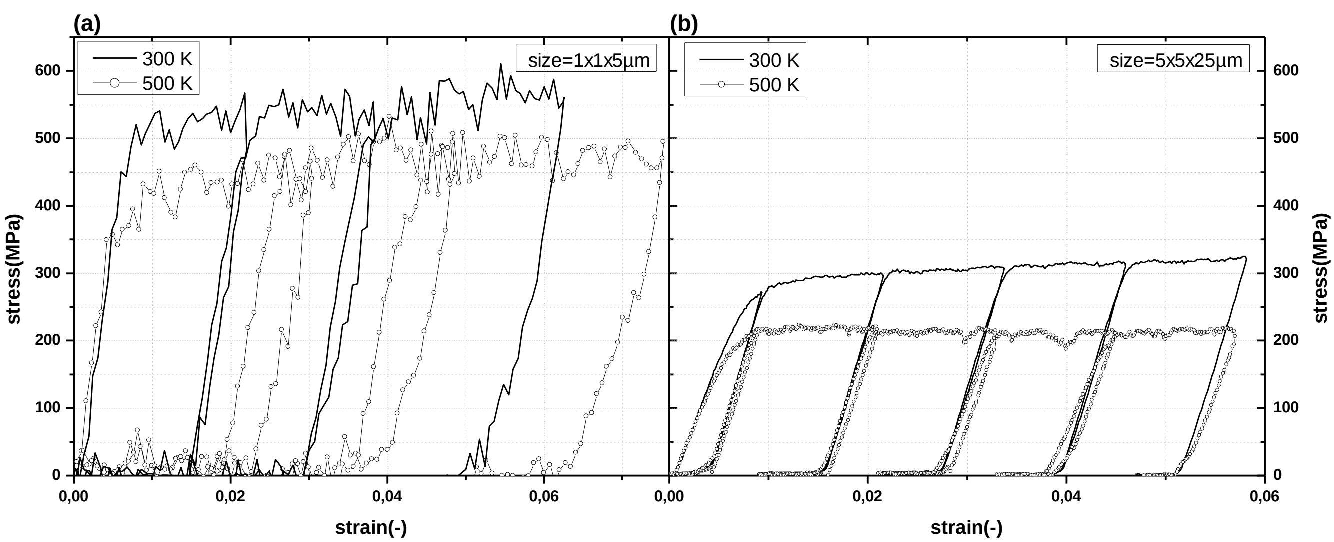


*Figure 1- stress-strain curve Cu-beams with the size (a) 1x1x5µm and (b) 5x5x25µm at 300 K and 500 K, respectively.*