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LOCAL 3-D STRAIN AND ORIENTATION MEASUREMENTS IN TENSILE STRAINED AND NANOINDENTED COPPER USING X-RAY MICROBEAMS

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We have used submicron resolution broad band-pass (white) x-ray microbeams and a newly developed x-ray microscopy depth-resolution technique to determine the local orientation and strain/stress in deformed Cu crystals within volume elements ~0.7 x 0.7 x 1.0 μm3. Spatially-resolved x-ray microbeam Laue diffraction measurements made on 40 MPa tensile strained Cu single crystals have been analyzed to determine lattice orientations and stress between dislocation-walls in tensile strained Cu. The dislocation cell structure and local lattice orientations observed using x-ray microbeams will be compared with TEM observations, and strain levels associated with the plastic/elastic deformation and dislocation walls in the tensile strained copper will be discussed. The measurements on nanoindented Cu were used to determine the spatial distribution of plastic deformation below the blade edge and flat face regions of Berkovich indents. Combinations of several lattice rotation systems were observed under the blade edge area, while nearly one-dimensional tilts were found below, and extending beyond, the flat faces of the indenter. The experimental techniques for 3-D x-ray microscopy will be discussed and the potential of the method for fundamental investigations of deformation will be considered.

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