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Interplay of stresses, plasticity at crack tips and small sample dimensions revealed by in-situ microcantilever tests in tungsten

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Abstract

The evolution and distribution of stresses and geometrically necessary dislocation densities during microcantilever testing were studied in-situ in a scanning electron microscope using high-angular resolution electron back scatter diffraction. Focused ion beam milling was used to prepare the beams with dimensions of ca. 5-7 μm in height and width and 20 μm in length in a tungsten single crystal along a $\langle 100 \rangle$ axis. Unnotched cantilevers were tested to gain insight into dislocation mechanisms leading to significant strengthening during loading. Locally increased yield and flow stresses were linked to pronounced stress gradients on specific slip planes and dislocation pile-ups at regions of zero stress. The limited plastic deformation behaviour of tungsten at room

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