INDENTATION BEHAVIOR OF SINGLE-CRYSTALLINE TUNGSTEN

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Tungsten has great potential for high temperature applications due to its very high melting point. Its brittleness far above room temperature, though, limits its application. Previous investigations have shown that plastic deformation and fracture toughness of polycrystalline tungsten strongly depend on the microstructural characteristics, such as grain size, grain shape, and texture. In this work, we aim at understanding the deformation behavior of tungsten at the microscale and in particular the influence of the strain gradients by combining nanoindentation and finite element modelling. First, in order to compare our experimental results with finite element modelling, different approaches to determine the projected contact area in the computational experiment were evaluated. Then, we quantitatively characterized the indentation size effect in tungsten single-crystals of different crystal orientations, which has frequently been described by the Nix-Gao model. While the model works well for large indentation depths, the application of the classic Nix-Gao model needs to be re-evaluated in the depth regime less than 200nm,which we will show by studying the material length scale h*.