Microstructure, mechanical behaviour and fracture of pure tungsten wire after different heat treatments - DTU Orbit (09/11/2017)

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Plastic deformation of tungsten wire is an effective source of toughening tungsten fibre-reinforced tungsten composites (Wf/W) and other tungsten fibre-reinforced composites. To provide a reference for optimization of those composites, unconstrained pure tungsten wire is studied after various heat treatments in terms of microstructure, mechanical behaviour and fracture mode. Recrystallization is already observed at a relatively low temperature of 1273 K due to the large driving force caused by a high dislocation density. Annealing for 30 min at 1900 K also leads to recrystallization, but causes a rather different microstructure. As-fabricated wire and wire recrystallized at 1273 K for 3 h show fine grains with a high aspect ratio and a substantial plastic deformability: a clearly defined tensile strength, high plastic work, similar necking shape, and the characteristic knife-edge-necking of individual grains on the fracture surface. While the wire recrystallized at 1900 K displays large, almost equiaxed grains with low aspect ratios as well as distinct brittle properties. Therefore, it is suggested that a high aspect ratio of the grains is important for the ductile behaviour of tungsten wire and that embrittlement is caused by the loss of the preferable elongated grain structure rather than by recrystallization. In addition, a detailed evaluation of the plastic deformation behaviour during tensile test gives guidance to the design and optimization of tungsten fibre-reinforced composites.

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