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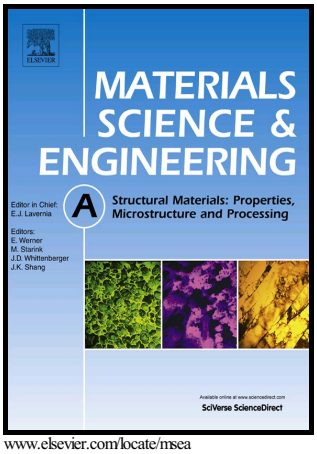

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The effect of heat treatments on pure and potassium doped drawn tungsten wires: Part I - Microstructural characterization

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Abstract

Advanced tungsten fibre-reinforced composites (W_f/W), showing pseudo ductile behaviour even at room temperature, are a promising option for future fusion reactors as the intrinsic brittleness of tungsten can be mitigated effectively. The drawn tungsten wires used as reinforcements are the key components of the composites, thus their mechanical properties and thermal stability define the allowed operation / fabrication temperature of the composite material itself. In this work, a comprehensive characterization of the pure and potassium doped tungsten wires was performed, focusing on the influence of various heat treatments on different microstructural features (nature of grain boundaries, grain shape and size, texture analyses) and mechanical properties. Annealing in the temperature range from 900-1600 °C enables the investigation of the microstructural stability of the two materials and arising annealing phenomena – recovery, recrystallization and grain growth. The results demonstrate that the pure tungsten recrystallizes fully in the temperature range 1300-1500 °C accompanied with tremendous coarsening and a complete loss of the initial fibrous, elongated grain structure. In contrast to this, potassium doped wire shows superior high temperature properties, where the performed heat treatments cause only milder microstructural changes, consequently suppressing recrystallization and grain growth to temperatures well above the investigated ones. Furthermore, hardness measurements and observed softening complement the discussion of the grain morphology evolution.

Keywords

Tungsten wires, potassium doping, microstructure, annealing, recrystallization, EBSD analyses