

Tungsten-based materials for plasma-facing components of future fusion reactors

Wolfgang Pantleon

Department of Civil and Mechanical Engineering, Technical University of Denmark

Plasma-facing components of future fusion reactors will have tungsten-based materials as armor. At operation temperature, the armor material will unavoidably undergo microstructural restoration microstructure as recovery, recrystallization and grain growth. As undeformed tungsten is inherently brittle, while deformed tungsten is ductile, embrittlement by recrystallization must be avoided, but the thermal stability of conventionally rolled tungsten turned out to be insufficient. Alternatively, pseudo-ductile tungsten fiber-reinforced tungsten composites with a tungsten matrix reinforced by heavily drawn tungsten wires are developed. Their thermal stability and microstructure evolution at high temperatures is analyzed using EBSD. During isothermal annealing, the drawn wires recrystallize, and the recrystallization nuclei grow into the surrounding matrix. To avoid such an intergrowth, an oxide interlayer is introduced keeping restoration in wire and matrix decoupled at least for temperatures up to 1400 °C. At higher temperatures, even thick yttria interlayers can neither prevent intergrowth nor preserve pseudo-ductility. Quantitative analysis of the occurring mechanism relay on an intricate analysis of the obtained orientation data revealing even exotic texture types (cyclic fiber and ring fiber textures) and incidental twins present.