Investigation of the mechanical properties and microstructure of W and WLa$_2$O$_3$ after high-speed hot extrusion

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Tungsten and tungsten-base materials are considered as promising materials for facing plasma components in fusion reactors, due their good thermomechanical properties, high melting temperature and low hydrogen solubility. Unfortunately these materials are brittle at low and intermediate temperatures. The aim of this work is to improve the ductility of W and W-base materials by high-speed hot extrusion. Two different materials W and W-La$_2$O$_3$, were hot extruded in a vertical press at 1000°C, under a pressure of 1.7GPa and using a high extrusion speed of $10^4$ s$^{-1}$. Following high speed hot extrusion, the W rod was observed to contain a lot of cracks, while a W-La$_2$O$_3$ rod with a diameter of 10 mm was successfully produced without any cracks. W-La$_2$O$_3$ appears clearly more ductile than W under high-speed hot extrusion. Microhardness measurements showed that the hardness of W increases slightly from 4550 to 4580 MPa, as a result from highspeed hot extrusion, while the hardness of W-La$_2$O$_3$ decreases from 5100 to 4670 MPa. In order to correlate mechanical properties to the microstructure extruded rods are being investigated by means of Charpy impact and tensile tests and scanning and transmission electron microscopy observations.

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