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MICROSTRUCTURAL AND MECHANICAL CHARACTERISTICS OF W-2Ti AND W-1TiC PROCESSED BY HOT ISOSTATIC PRESSING

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It has been demonstrated that mechanical alloying and subsequent consolidation by hot isostatic pressing (HIP) is a successful route to produce dispersion strengthened W alloys with properties satisfying the design requirements of particular plasma facing components in the fusion reactor. However, the presence of the alloying element as a phase filling large interstices between W particles appears to reduce the mechanical properties of these alloys. In order to limit this phase separation induced by the HIP treatment and the detrimental effects on the mechanical properties, the enhancement of the mechanical alloying process, and the effect of a post-consolidation heat treatment in an reducing atmosphere, have been investigated.

W-2Ti and W-1TiC alloys have been produced via a powder metallurgy route consisting of mechanical alloying during 75 h and 50 h, respectively, and a subsequent consolidation by HIP for 2 h at 1573 K and 200 MPa. The particle sizes of the starting powders were <5 μm for W, <110 μm for Ti and <40 nm for TiC. The evolution of the lattice parameters, accumulative microstrain and crystallite sizes of the powder at increasing milling times has been analyzed by X-Ray diffraction measurements, and its microstructure by scanning electron microscopy. The increasing of the oxygen content has been determined by infrared absorption and thermal conductivity, and particle size distributions by laser light scattering. The consolidated alloys show fine grained microstructures. In W-1TiC a good dispersion of TiC particles with sizes <50 nm is observed.

Three point bending tests up to 1200 ºC have been performed on the consolidated alloys in the as-HIP condition and after a reducing thermal heating at 1200 ºC for 1 h in Ar-10%H_2. The results show a slight enhancement of the bending properties and smaller uncertainty in the bending strength measurements upon the reducing treatment. The maximum bending strengths of 800 and 900 MPa are found at 800 ºC for W-2Ti and W-1TiC, respectively.

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