EFFECT ON NANOINDENTATION IN LA_2O3-REINFORCED W AND W–V ALLOYS PRODUCED BY HOT ISOSTATIC PRESSING

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W is a principal candidate material for fabricating plasma facing components (PFC) in a future fusion power reactor due to its high melting temperature, good thermal conductivity, thermal stress resistance, low tritium retention and high temperature strength [1]. For these applications, the structural materials should have an operating temperature window 873-1600 K and a ductile brittle transition temperature (DBTT) in the interval 573-673 K, as well as a recrystallization temperature (RT) above1600 K [2]. La_2O_3 dispersion or Al, K, Si doping can improve the mechanical strength and increase the tungsten RT, although the DBTT appears not to be lowered [3]. Most of these W alloys were prepared by powder metallurgy methods, in particular by ball milling and subsequent pressure less sintering or hot isostatic pressing (HIP) [3]. Recently, W and WTi alloys reinforced with Y_2O_3 have been sintered by HIP [4]. The use of Ti as sintering activator and the Y_2O_3 dispersion result in full dense materials exhibiting improved mechanical properties and oxidation resistance [5]. However, the Y_2O_3 particles in a W matrix appear to be unstable at temperatures above 1600 K becoming into coarse particles of complex W-Y and W-Y-Ti oxides, which could worsen the mechanical properties. This drawback may be avoided if V is used as sintering activator. The V-W system exhibits an isomorphous phase diagram with a continuous range of solid solution [6].

The aim of the present work is to produce W and W-V alloys reinforced with La_2O_3 particles and investigate their microstructure and thermal stability in order to obtain a structural material with favor able properties to be used for developing PFC. W and W-V alloys reinforced with La_2O_3 particles have been produced by MA and subsequent HIP at 1573 K and 195 MPa. The microstructure of the consolidated alloys has been characterized by scanning electron microscopy, energy dispersive spectroscopy analyses and X-ray diffraction. The mechanical properties were studied by nanoindentation measurements. The results show that practically full dense billets of W-V, W-V-La_2O_3 and W-La_2O_3 alloys can be produced. The microstructure analysis has shown that islands of V are present in W V and W V-1La_2O_3 alloys. In W-1La_2O_3 islands of La_2O_3 are also present. The nanohardness of the W matrix increases with the addition of V, while decreases with the addition of La_2O_3.

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