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Characterizations of the tantalum cladded tungsten blocks prepared by hot isostatic pressure (HIP) diffusion welding

The solid spallation neutron source target is used in the condition of high temperature, high radiation and continuous cooling water erosion. In order to obtain a high neutron yield, the target material is generally selected from the metal material with a relatively high atomic number. Tungsten is one of the suitable choices as the spallation neutron sources solid target material due to its high efficiency of neutron, excellent heat removal ability and high melting point. Many spallation neutrons sources, tungsten is selected as the target material such as KENS, LANSCE, ISIS and ESS. However, tungsten has poor corrosion resistance performance especially subjected to the irradiation and corrosion environment. It is an effective method to solve the poor corrosion performance of tungsten by coating the tungsten surface with corrosion-resistant metals such as tantalum, niobium, titanium or zircaloy.

Tantalum (Ta) coated tungsten (W) blocks were prepared by hot isostatic pressure (HIP) diffusion welding in the temperature range from 1250 ℃ to 1550 ℃. The mechanical tensile properties displayed that the bonding strength of the W-Ta interface reached the maximum value of 139.9 MPa at 1450 ℃. The value of nanoindentation hardness values of the W-Ta interface are between the values of W and Ta substrates indicating the diffusion layer. W-Ta diffusion layers were formed during the HIP, and the thickness of diffusion layers increased with the increase of the HIP temperature. TEM results show that the diffusion layer consists of W-Ta solid solution, and crystal plane distances of the diffusion layers were slightly enlarged due to the W-Ta solid solution.

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