

HE-COOLED DIVERTOR FOR DEMO: TECHNOLOGICAL STUDY ON JOINING TUNGSTEN COMPONENTS WITH TITANIUM INTERLAYER

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A modular He-cooled divertor concept for DEMO [1] has been pursued at KIT with the goal of reaching 10 MW/m^2 . The reference design uses small tungsten-based cooling fingers of about 20 mm in size. They consist of a tungsten tile as thermal shield which is to be connected to a thimble heatsink structure from W-1 wt% La_2O_3 (WL10) tungsten alloy. The lower boundary of the divertor operating temperature window is dictated by the ductile-to-brittle temperature and the upper boundary by the recrystallization temperature of WL10 material, currently assumed at 600 °C and 1300 °C, respectively.

The important requirements for the joint between W tile and WL10 thimble are: a) functioning as a crack stopper, b) resisting a high operating temperature of about 1200 °C, and c) using low activating material as an interlayer. Previously PdNi brazing material has been successfully tested at a brazing temperature of about 1270 °C. The so produced mockups are sufficiently suitable for the HHF tests without neutrons. In a further step to approach the DEMO requirements with higher demanding, the use of low-activating titanium with a melting point of 1668 °C as bonding material was studied both for brazing as well as for diffusion welding of tungsten parts. This paper reports on the first successful test results of both high-temperature brazing and diffusion bonding joining techniques.

[1] P. Norajitra, et al., Progress of He-cooled Divertor Development for DEMO, Fusion Eng. Des. 86 (2011) 1656–1659.

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