IAEA FEC 2014

Contribution ID: **699** Type: **Poster**

Development of Tungsten Monoblock Technology for ITER Full-Tungsten Divertor in Japan

Wednesday 15 October 2014 14:00 (4h 45m)

Through R&D for a plasma facing unit (PFU) of a full-tungsten (W) ITER divertor, Japan Atomic Energy Agency (JAEA) succeeded in demonstrating the durability of the W divertor which endured a repetitive heat load of 20 MW per sqare meter without macroscopic cracks of all W armors. At the beginning of this activity, the bonding technology armor to heat sink was one of the most important key issues in a manufacturing process. JAEA improved the bonding process of the W divertor mock-ups. At first the bonding between the W armor and the copper interlayer (Cu) is performed by using several technologies, such as “Direct casting of Cu” or “Diffusion bonding” or “HIP bonding”. Then the brazing between the Cu and the cooling pipe is done. Then the rejection rate due to those bonding processes has been significantly been reduced. As a performance test for the bonding and a heat removal capability, the high heat flux testing was carried out for 6 small-scale mock-ups for the R&D of the full-W ITER divertor. Moreover, a W part of 4 full-scale prototype PFUs were also tested. In the tests, all of the W monoblocks endured the repetitive heat load of 10 MW per sqare meter for 5,000 cycles and 20 MW per sqare meter for 1,000 cycles without the macroscopic crack, which strongly encourages the realization of the full-W divertor target from the start of the operation in ITER. This paper presents the latest R&D activities on the full-W ITER divertor in JAEA.

Paper Number

FIP/1-2Ra & FIP/1-2Rb

Country or International Organisation

Japan & France

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Session Classification: Poster 4