FABRICATION AND HIGH HEAT FLUX TEST WITH THE BE/FMS MOCK-UPS FOR

FIRST WALL OF KO HCML TBM

Dong Won Lee¹, Suk Kwon Kim¹, Young-Dug Bae¹, Yang-Il Jung¹, Jeong Yong Park¹, Yong

Hwan Jeong¹

¹ Korea Atomic Energy Research Institute Corresponding author: dwlee@kaeri.re.kr

Korea has proposed and designed a Helium Cooled Molten Lithium (HCML) Test Blanket Module (TBM) to be tested in the ITER. Ferrite Martensite (FM) steel and Be are used as the structural material and armor, respectively in the first wall. He is used as a coolant and liquid lithium is circulated for a tritium breeding, not for a cooling purpose. Therefore, the speed of lithium is very slow up to a few mm/sec. In order to develop the fabrication technology for a TBM structure, joining of FM steel to FM steel has been developed and proved through the high heat flux (HHF) test. Simultaneously, joining of Be to FM steel has been developed with several interlayers and mock-ups were fabricated with Hot Isostatic Pressing (HIP). Since the integrity of the fabricated mock-ups should be evaluated, a high heat flux test was performed with up to 1.0 MW/m² of a heat flux using KoHLT-1 (Korea Heat Load Test facility). The test conditions were determined with ANSYS-11 and the test results were compared with the preliminary analysis ones. For Be to FMS joining, mock-ups were successfully fabricated with a HIP (580 °C, 100 MPa, 2 hours) by trying the different interlyers (1µm-Ti/0.5µm-Cr/5µm-Cu and 1µm-Cr/5µm-Cu). In the same way, HHF tests with a KoHLT-1 were performed with 1,000 cycles under 1.0 MW/m² heat flux. During the test, there was no sudden increase of temperature but UT and DT results after the test showed a delamination in the case of using Ti/Cr/Cu interlayer. But the mock-up with the Cr/Cu interlayer showed a sound joining even after HHF test.

[1] Dong Won Lee, et. al., "Current status and R&D plan on ITER TBMs of Korea," J. of Korean Phys. Soc. 49, (2006) S340-S344.

[2] Dong Won Lee, et. al., "Preliminary design of a helium cooled molten lithium test blanket module for the ITER test in Korea," Fusion Eng. Des. 82 (2007) 381-388.

[3] Dong Won Lee, et. al., "Helium cooled molten lithium TBM for the ITER in Korea," Fusion Sci. and Tech. 52 (2007) 844-848.

[4] Dong Won Lee, et. al., "Design and preliminary safety analysis of a helium cooled molten lithium test blanket module for the ITER in Korea," Fusion Eng. Des. 83 (2008) 1217-1221.

[5] Y. D. Bae, et. al., "Development of a high heat flux test facility for plasma facing component," Fusion Sci. and Tech. 56 (2009) 91-95

[6] J. Y. Park, et. al., Optimization of joining condition for ITER first wall fabrication, J. Korean Phys. Soc. 49, (2006) S442-S446.

[7] Dong Won Lee, et. al., "Development of Fabrication and Qualification Methods for the First Wall of the International Thermonuclear Experimental Reactor (ITER)," J. Korean Phys. Soc. 51, (2007) 1210-1215.

[8] Dong Won Lee, et. al., "High heat flux test with HIP bonded Cu/SS mock-ups for the ITER first wall," Fusion Eng. Des. 83 (2008) 1038-1043.

[9] Dong Won Lee, et. al., "Fabrication and high heat flux test of the first wall mock-ups for the Korean He Cooled Test Blanket (KO HCML TBM)," Fusion Eng. Des. 84 (2009) 1164-1169.