

Performance Evaluation of Test Blanket Module First Wall and High Heat Load Testing in Fusion Research

Suk-Kwon Kim*, Chang Wook Shin, Seong Dae Park, Hyung Gon Jin, Sunghwan Yun, Dae-Sik Chang, Jae-Sung Yoon, Dong Won Lee

Korea Atomic Energy Research Institute, Daejeon, Republic of Korea

*Corresponding author: skkim93@kaeri.re.kr

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1. Introduction

Significant efforts are being made to develop the Test Blanket Module (TBM) [1] First Wall, a core component in fusion research. The TBM First Wall is critical for withstanding the extreme conditions generated by fusion plasma, and various research activities are underway to advance its development. We are actively engaged in performance testing using high heat load testing facilities [2,3], which are essential for assessing the manufacturability and thermo-hydraulic performance of TBM First Walls under fusion-relevant conditions. Domestic efforts have focused on the fabrication and testing of key fusion components, including the ITER blanket first walls and TBM first walls. Recent progress includes performance testing of the KSTAR tungsten divertor. Additionally, mockup tests have been conducted to develop First Walls for the domestic DEMO project [4]. This work aims to provide a comprehensive overview of the current status of TBM First Wall development, including the various research activities, testing facilities, and ongoing projects. The presentation will also outline future plans and detail the status of high heat load testing facilities, along with upgrade plans to further enhance research capabilities.

2. Methods and Results

2.1 Performance testing

For the thermo-hydraulic performance evaluation of the TBM First Wall, a test mockup was fabricated, as shown in Fig. 1. The mockup reproduced the cooling structure of the actual TBM First Wall. To monitor the mockup temperatures, five holes were machined to install thermocouples, and surface temperatures will be measured simultaneously to verify temperature trends.



Fig. 1. Performance testing mockup for TBM first wall.

2.2 Experimental results

The initial test results are as follows. As shown in Figure 2, the surface temperature was measured using a pyrometer, and the T/C temperature results are also presented. Through additional experiments, we plan to verify the uniformity of the temperature distribution and the integrity of the mockup's weld joints after repeated thermal loading.

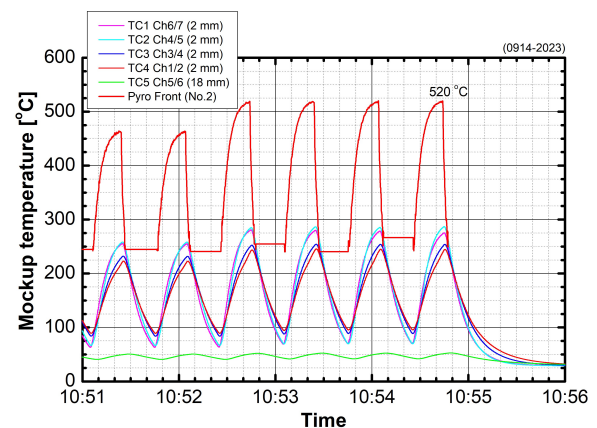


Fig. 2. Surface and T/C temperature of performance testing mockup.

3. Conclusions

Developing and testing the TBM First Wall have led to significant advancements in fusion research. High heat load testing has proven essential in evaluating the performance under extreme conditions, supporting the progress of domestic DEMO projects. Ongoing research and future enhancements to testing facilities will further strengthen the capabilities in fusion technology.

REFERENCES

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