

Status of J-PARC Transmutation Experimental Facility Program

(3) Numerical design analyses for the TEF-T lead-bismuth spallation target

*Tao Wan¹, Hironari Obayashi¹ and Toshinobu Sasa¹

¹ J-PARC Center, Japan Atomic Energy Agency

To improve the safety margin of TEF-T lead-bismuth spallation target, it is necessary to eliminate the stagnant flow region in liquid lead-bismuth and to reduce the stress level on the target vessel. For this purpose, the target design has been performed by applying the CFD analyses and the structural analyses. Results showed that the safety margin of target can be improved effectively by the modification of target inner structure.

Keywords: J-PARC, ADS, TEF-T, Lead-bismuth spallation target, CFD, structural analysis, safety margin

1. Introduction

A Lead-Bismuth Eutectic (LBE) spallation target will be installed to the ADS Target Test Facility (TEF-T), which will be constructed within the framework of J-PARC project to carry out basic R&Ds for the future ADS. The spallation target will be bombarded by pulsed proton beams and cooled by LBE (Fig. 1). Target designs were performed to reduce the temperature and thermal stress level on the beam window (BW) to improve the safety margin of the target.

2. Improvement of the TEF-T target design

Figure 2 shows two stagnant flow regions were formed in LBE for the original target: a) in the inner tube, and b) at the center of BW [1]. Temperature in these regions are higher than surrounding area. To eliminate the stagnant flow region in the inner tube, flow slits were added to the inner tube. For the stagnant region around the center of the BW, two types of modifications were tested: 1) add flow guides between the LBE vessel and inner tube (Design A), and 2) change the shape of BW (Design B). Comparing with original design, temperature and generated thermal stress on the BW were reduced (Fig. 3). Results illustrates that the modified designs can eliminate the stagnant flow region effectively and improve the target safety margin obviously.

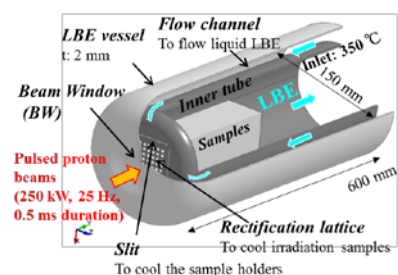


Fig. 1 Schematic drawing of LBE spallation target in TEF-T

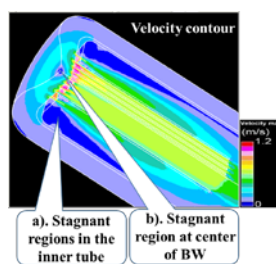


Fig. 2 LBE flow behavior for the original design target

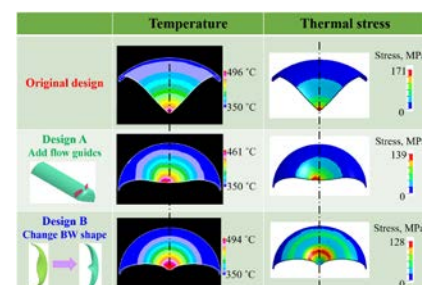


Fig. 3 Comparison of results between the original design, Design A and Design B.

References

- [1] Tao Wan, Hironari Obayashi, and Toshinobu Sasa, "Numerical study on LBE flow behavior of the TEF-T LBE spallation target at JAEA", in Proceedings of NUTHOS-11, N11P0102 (2016).

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