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P3.180 Neutronics Analysis of fusion breeding blanket concept to reduce peak of nuclear heat distribution

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The high peak value of nuclear heat distribution in the fusion breeding blanket is expected to make cooling system design difficult for DEMO. The maximum peak value of about 10 W/cm³ is assumed in the Test Blanket Module with the maximum operational power of 700 MW in ITER. The peak value of nuclear heat distribution in the blanket of DEMO will be increased in proportion to the operational power and a few hundreds of W/cm³ are estimated as the maximum peak in the blanket of DEMO with the operational power of a few thousand of MW.

In this study, neutronics analysis for the blanket design reducing the peak value of radial nuclear heat distribution was performed considering the operation power of DEMO. The peak nuclear heat is generated in the breeder mainly due to the nuclear reaction of Li-6 for the blanket design of the separated breeder and multiplier composition. Therefore, the blanket concept mixing the functional materials of breeder and multiplier were considered to reduce the nuclear heat peak in the breeder. At first the Liberite was considered as the functional material of the blanket. The Liberite, Li₂BeSiO₄, is a mineral including Li and Be. Secondly, a functional material similar with TRISOL which is one of the fuel types used in the VHTR, was considered. It is assumed that the Li pebble (Li₂TiO₃) with Be coating is used as the functional material of the blanket. The tritium production or tritium breeding and nuclear heat distribution were evaluated with the proposed blanket design. Additionally, re-loading of the spent functional material was evaluated based on the Li burn-up calculation, considering long-term operation and production of radioactive waste.

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