反应堆工程

中国氦冷固态实验包层2×6模块中子学计算分析

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摘要　　为了满足ITER对波纹度的要求，核工业西南物理研究院提出了新的减少低活化铁素体钢的氦冷固态（HCSB）实验包层模块（TBM）设计方案。采用MCNP程序及ITER全堆MCNP模型，对新设计的2×6 HCSB-TBM进行三维中子学计算分析，给出了模块产氚率、核热沉积和功率密度分布等结果。在ITER运行因子为22%时，HCSB-TBM的产氚率为12.68 mg/d。TBM内总核热沉积为522.5 kW，最高功率密度为11.8 W/cm^3，出现在氚增殖区Li$_4$SiO$_4$中。计算结果可为TBM进一步的结构、热工水力学优化及其他系统设计提供中子学数据。

Neutronics Calculation Analysis for China 2×6 Helium-Cooled Solid Breeder Test Blanket Module

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Abstract　In order to meet the requirement of ITER toroidal field ripple effect, a new design of helium-cooled solid breeder test blanket module (HCSB-TBM) with reduced low activation ferritic martensitic stainless steel (LAFM) was proposed by Southwestern Institute of Physics. By using MCNP code and global ITER MCNP model, 3D neutronics calculations for the new 2×6 HCSB-TBM design were performed and the results of tritium generation rate, nuclear heating deposit and power density distribution were obtained. The tritium production rate is about 12.68 mg/d while considering ITER duty factor of 22%. The TBM total nuclear heating deposit is about 522.5 kW, and the peak power density is 11.8 W/cm^3 which appears in Li$_4$SiO$_4$. The results can provide neutronics data for TBM further structural and thermal-hydraulic optimization and design of other systems.

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