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反应堆工程

聚变堆混和球床包层中子学和热工水力特性研究

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摘要 在聚变堆初步概念设计的基础上，针对固态包层设计路线，提出了一个先进的氦冷固态包层概念。设计采用$Be_{12}Ti$和Li_2TiO_3陶瓷小球混和球床，物理和化学相容性好；采用SiC作为结构材料，提高耐高温性能及氦气出口温度。计算结果表明：选择$Be_{12}Ti$和Li2TiO$_3$球体积比在2和4之间较合理；在$Be_{12}Ti$和Li_2TiO_3球体积比为3时，^{6}Li富集度取30%~80%较适宜；球床的最高温度低于材料的温度限值，温度分布合理均匀。该方案可较大程度提高热效率和改善中子学以及氚增殖性能。

关键词

聚变堆 氦冷固态包层 混和球床 氚增殖率

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Study on Neutronics and Thermo-hydraulics for Mixed Pebble Bed Blanket of Fusion Reactor

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Abstract

Based on the preliminary design of fusion reactor, aiming at the outline of solid blanket design, an advanced helium cooled solid blanket concept was developed. $Be_{12}Ti$ and Li_2TiO_3 mixed pebble bed as neutron and tritium breeder which has high compatibility was adopted, and SiC as structure material which can endure high tempera ture for increasing the temperature of helium outlet. Calculation results show that the volume ratio of $Be_{12}Ti$ and Li_2TiO_3 should properly approximate between 2 and 4. In case of selecting 3 as volume ration of $Be_{12}Ti$ and Li_2TiO_3, ^{6}Li enrichment ranged between 30% and 80% is suitable. The maximum temperature in the pebble bed is below the limited temperature of blanket material, and temperature distribution is reasonable properly uniform. This scheme can improve the thermal efficiency as well as neutronics and tritium breeding performance.

Key words fusion reactor helium cooled solid blanket mixed pebble bed tritium breeding ratio

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