Theoretical Calculation and Analysis Modelling for the Effective Thermal Conductivity of Lithium Metatitanate Pebble Bed

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Abstract

ITER is a joint international research and development project that aims to demonstrate the scientific and technical feasibility of fusion power. A main function of ITER is to test the tritium producing TBM (Test Blanket Module). In IN-LLCB (Lead Lithium Cooled Ceramic Breeder) TBM lithium matatitanate (Li2TiO3) has been selected as tritium breeder material in form of pebbles. The effective thermal conductivity of Li2TiO3 pebble bed is an important design parameter and must be known for the thermo-mechanical design of solid breeder blankets. In this paper, the theoretical calculation and modelling analysis for the effective thermal conductivity of Li2TiO3 pebble bed are performed. The 2D and 3D theoretical equations for the thermal conductivity of Li2TiO3 pebble bed are derived, and compared with the modelling results using COMSOL Multiphysics as a numerical tool. The effective thermal conductivity of Li2TiO3 pebble bed can be preliminarily obtained by analysis modelling or theoretical calculation under the lack of experimental set-up at present. It might be a feasible choice to firstly calculate and model the effective thermal conductivity of pebble bed based on the heat transfer law of Fourier before going for experimental evaluation of pebble bed thermal conductivity.

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