HE BUBBLES NUCLEATION IN LEAD-LITHIUM AND IMPLICATIONS ON TRITIUM TRANSPORT FOR HCLL BREEDING BLANKET DESIGN

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Tritium self-sufficiency in D–T reactors is linked to high helium production rates in liquid metal (LM) breeding blankets. The existence of a large number of long residence time nano- or micro- bubbles in the LM might act as an effective sink for tritium. The issue of He bubbles formation is, hence, highly relevant to tritium inventory control and recovery.

Models for tritium and helium transport phenomena involving He nucleation, bubble growth, T absorption into He bubbles, T adsorption onto structural material and desorption to cooling system channels (CSC) are implemented into OpenFOAM® CFD code (BelFoam solver). The code has been upgraded with a conjugated scalar transfer algorithm in order to take into account LM-structural material interface and to couple solid and liquid domains, both for heat and mass transfer.

In the present work models for tritium and helium transport and BelFoam solver results for a HCLL breeding unit are shown; a horizontal U-shaped channel geometry is assumed for computational purposes. A sensitivity analysis of the mean channel pressure effect on bubble nucleation is presented together with an analysis of the results and their implications for the design of LM breeding blankets.

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