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Predicting bubble departure frequency in CFD from thermal boundary layer energy limit[1] RAVIKISHORE KOMMAJOSYULA, EMILIO BAGLIETTO, Massachusetts Inst of Tech-MIT, BAGLIETTO CFD RESEARCH GROUP TEAM — Second generation boiling closures for CFD being developed at MIT aim at accurately capturing the subgrid scale phenomena to gain improved accuracy and extended applicability. Here we focus on the key aspect of predicting the bubble departure frequency, and replace the current correlation based methods with a physically based mechanistic model. While various attempts have been made in literature, they have all relied on the Hsu's criterion, which makes them highly dependent on the nucleation cavity size and not applicable to general CFD applications. A new approach is proposed to evaluate the bubble wait time, which is based on capturing the energy limit of the thermal boundary layer (TBL). The TBL develops during the short time span following bubble departure, when subcooled liquid quenches the surface, but as the TBL growth reaches a critical thickness its inertia increases and the excess heat is directed towards bubble nucleation. The energy limit is analyzed over an extended experimental database and a fully mechanistic model for predicting the bubble wait time is proposed. The new model can be used in conjunction with the bubble growth time to accurately predict the bubble departure frequency.

[1]CASL - Consortium for Advanced Simulation of Light Water Reactors

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