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Direct numerical simulations of EHD-enhanced film boiling
PAYAM SHARIFI, ASGHAR ESMAEELI, Southern Illinois University at Carbondale — Boiling is one of the most efficient modes of heat exchange. Yet, in applications involving boiling in micro-devices or under microgravity conditions it is extremely desirable to enhance the heat transfer rate even further to increase the efficiency of these systems. An enhancement mechanism that is particularly attractive is the one due to application of an electric field to the bulk of fluid. Here, the dielectric mismatch between the liquid and vapor phases results in convective flows and, therefore, a higher heat transfer coefficient. While the enhancement of heat and mass transfer by electric field has been known for decades, a fundamental understanding of the problem is still lacking primarily due to difficulties in conduct of experimental and theoretical studies. The current advances in development of numerical methods for direct simulations of multiphase flows, however, have opened up enormous possibilities for detailed understanding of this problem. Such simulations can make it possible to capture the highly unsteady dynamics of the boiling flows. Here, we present a front tracking algorithm in conjunction with a leaky-dielectric electrohydrodynamic (EHD) model to study EHD-enhanced film boiling on horizontal surfaces. The goal is to compare the average wall Nusselt number at different strengths of the electric field and to correlate the macroscopic behavior of the flow with the dynamics of the phase boundary.

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