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Simulation Prediction of Transient Dropwise Condensation[1] ASHLEY MACNER, SUSAN DANIEL, PAUL STEEN, Cornell University — In order to design effective surfaces for large-scale dropwise condensation, an understanding of how surface functionalization affects drop growth and coalescence is needed. The long term technological goal is a set of design conditions to help NASA achieve maximum heat transfer rates of waste heat generated from electronics and habitable environments under microgravity conditions. Prediction of condenser surface heat transfer performance requires accurate simulation and modeling of the evolution of populations of drops in time. At shorter times, drops are primarily isolated and grow mainly by condensation onto the liquid-gas interface. At longer times, drops grow mainly by coalescence with neighbors. Simulation of dropwise condensation on a neutrally wetting surface and comparison with our previous experimental results is reported. A steady-state single drop conduction model is empirically fitted to determine a temperature profile that captures the drop size evolution. The simulation accurately predicts the continuous time evolution of number-density of drops, drop-size distributions, total condensate volume, fractional coverage, and median drop-size for both transient and steady states, all with no free parameters.

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