Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

The thermodynamic principle governing the interface temperature during phase change TOM ZHAO, NEELESH PATANKAR, Northwestern University — The interface temperature during phase change (for instance, liquid to vapor) has traditionally been underspecified because the heat balance condition is used to determine the amount of mass changing phase. A common approach in boiling is to assume that the interface attains the saturation temperature according to the ambient pressure. This assumption is usually applied even under highly non-equilibrium scenarios where significant temperature jumps and mass transport exist across the interface. In this work, an ab-initio thermodynamic principle is found to fully determine the interface temperature under non-equilibrium scenarios. Physically, the thermodynamic principle not only provides a theoretical limit on the space of possible phase change rates that can occur, but also specifies the corresponding phase change rate. This principle accurately captures experimental and computational values of the interface temperature that deviate by over 50% from the assumed saturation values. It also accounts for temperature jumps (discontinuities) at the interface whose difference can exceed 15 K. We find that this thermodynamic principle is a robust model to complete the phase change problem.

Tom Zhao
Northwestern University

Date submitted: 29 Jul 2020 Electronic form version 1.4