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EXPRESSIONS FOR THE EVAPORATION AND CONDENSATION COEFFICIENTS IN THE HERTZ-KNUDSEN RELATION

Abstract

Accurate fluid properties are of fundamental importance in designing experiments for both gravity and microgravity environments. Even when care is taken to ensure that the experiments lead to accurate measurements, correct fluid properties are required to properly analyze and interpret the data. The reported values of the evaporation and condensation coefficients that appear in the Hertz-Knudsen relation for evaporation strongly disagree under nominally the same experimental conditions. Two assumptions were made in these investigations: 1) the interfacial liquid and vapor temperatures were assumed equal during evaporation, but subsequent studies have indicated that these temperatures could be different by several degrees K, and 2) no expressions for the coefficients were available so they were assumed equal, denoted σ. Since interfacial temperatures were assumed equal, depending on which temperature was chosen as the interfacial temperature, the inferred values of σ varied over a wide range. When the classical limit of the quantum-mechanically-based statistical rate theory (SRT) expression for the evaporation flux is taken, the Hertz-Knudsen relation is obtained, but with explicit expressions for the evaporation and condensation coefficients. If the SRT-derived Hertz-Knudsen expression is used with either water or ethanol steady-state evaporation experiments, one finds that the evaporative latent heats and the constant pressure specific heats as functions of temperature can be predicted, and that the predictions are in agreement with independent measurements.