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General linear theory for sound waves accompanied with evaporation and condensation MASASHI INABA, Division of Mechanical and Space Engineering, Hokkaido University, TAKERU YANO, Department of Mechanical Engineering, Osaka University, MASAO WATANABE, Division of Mechanical and Space Engineering, Hokkaido University — When a sound wave in a vapor is reflected at an interface between the vapor and its liquid, the evaporation and condensation occurs in addition to the partial penetration of the wave into the liquid. Although the sound propagation outside the boundary layer is as usual governed by the linear wave equation, the boundary condition at the interface should carefully be treated in the kinetic theory of gases even if the Knudsen number (Kn) defined by the ratio of the mean free path of gas molecules to a typical wavelength is sufficiently small compared with unity. We therefore execute a general analysis of the entire flow field by using the ES-BGK model of the Boltzmann equation applicable to polyatomic gases and a general kinetic boundary condition at the interface. As a result of the asymptotic analysis for small Kn with the assumption that an acoustic Mach number is sufficiently small compared with Kn, we retrieve the linearized Euler equations outside the boundary layer and the so-called slip boundary conditions for the Euler and boundary layer equations. The coefficients in the slip conditions are determined by the Knudsen layer analysis. The effect of phase changes on the waves is illustrated by a simple example of plane standing wave.

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