Instabilities in a horizontal liquid layer in co-current gas flow with an evaporating interface

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The problem of a two-layer system consisting of a horizontal liquid layer in contact with its own vapor is considered. The liquid layer is bounded by a rigid walls from below, and phase change can occur at the interface. The flow of the vapor phase is driven by a constant pressure gradient in the streamwise direction. We have taken into account the effects of buoyancy, thermocapillary, evaporation and the dynamic of the vapor phase. A full linear stability analysis is performed using a Chebyshev spectral method. The influences of evaporation effect and the interfacial shear on the Rayleigh instability and the Marangoni instability have been studied. The results show that both the evaporation and the interfacial shear play important roles in the stability of the system.