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Motion of a Drop above an Evaporating Liquid-Gas Interface[1]

LAEL FISHER, ALEXANDER GOLOVIN, Northwestern University — Motion of a drop above a planar evaporating liquid-gas interface is consedered. Thermal gradients in the gas and liquid phases result in Marangoni flows that govern the drop motion. Using bi-spherical coordinates, the equations of motion and diffusion of vapor and heat are solved in the Stokes and zero Peclet number approximations, respectively, and the drop velocity is found as a function of the separation distance from the planar interface. It is shown that, in the absence of gravity, there is a critical distance below which the drop moves towards the interface and above which it moves away from it. In the presence of gravity, there can be two critical distances, the smaller stable and the larger unstable, the latter corresponding to a drop levitating above the planar interface in a state when the gravity, Marangoni and lubrication forces are balanced. These results can explain some experimental observations of microscopic water drops condensing above the surface of evaporating liquid films.

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