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Diffusion-Controlled Evaporating Stationary Meniscus in a Channel JEAN-PIERRE NJANTE, STEPHEN MORRIS, UC Berkeley — Isochemical liquid evaporates into a mixture of its own vapor and an inert component. On one wall, the contact line is pinned; the other wall is perfectly wetted. These walls are at uniform temperature T_o equalling that of the distant gas. Liquid evaporates because the partial pressure p^v_∞ of the distant vapor is less than the saturation pressure P evaluated at T_o and pressure p^ℓ_∞ of the distant liquid. Evaporation draws liquid into the contact region; near the wetted wall, the resulting pressure differences distorts the interface, creating an apparent contact angle. θ is a flow property and increases with the control parameter $P(p^\ell_\infty, T_o) - p^v_\infty$. As a preliminary to finding θ, we prove the following; (a) The system is effectively isothermal; though evaporation induces liquid temperature differences, they are kinetically negligible. (b) Whenever the continuum approximation holds within the gas, diffusion is rate-limiting. As a result, liquid and vapor at the interface are in local thermodynamic equilibrium; the vapor partial pressure is related to liquid pressure by Kelvin's equation $p^v = P(p^\ell, T_o)$. Given (a) and (b), the film thickness $h(x)$, is determined by a system comprising of the steady state diffusion equation for $p^v(x, y)$, the lubrication equation for $p^\ell(x)$, and the augmented Young-Laplace equation for h. These equations are coupled by Kelvin's equation. We use our solution to address the corresponding problem for a droplet on a substrate.

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