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Apparent contact angle of an evaporating drop S.J.S. MORRIS, U.C. Berkeley — In experiments by Poulard et al. (2005), a sessile drop of perfectly wetting liquid evaporates from a non–heated substrate into an under–saturated mixture of vapour with an inert gas; evaporation is limited by vapour diffusion. The system exhibits an apparent contact angle θ that is a flow property. Under certain conditions, the apparent contact line was stationary relative to the substrate; we predict θ for this case. Observed values of θ are small, allowing lubrication analysis of the liquid film. The liquid and vapour flows are coupled through conditions holding at the phase interface; in particular, vapour partial pressure there is related to the local value of liquid pressure through the Kelvin condition. Because the droplet is shallow, the interfacial conditions can be transferred to the solid–liquid interface at $y = 0$. We show that the dimensionless partial pressure $p(x, y)$ and the film thickness $h(x)$ are determined by solving $\nabla^2 p = 0$ for $y > 0$ subject to a matching condition at infinity, and the conditions $-p = \mathcal{L}h_{xx} + h^{-3}$ and $(h^3 p_x)_x + 3p_y = 0$ at $y = 0$. The parameter $\mathcal{L}$ controls the ratio of Laplace to disjoining pressure. We analyse this b.v.p. for the experimentally–relevant case $\mathcal{L} \to 0$.

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